Regional Competitiveness, Innovation and Environment

Edited by
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Preface

Present volume has been prepared by the Institute of Economics and Economic Development on the occasion of the 10th anniversary of the foundation of the Faculty of Economics and Business Administration at University of Szeged. It provides a review of the recent research fields of the Institute.

The Institute of Economics and Economic Development consists of two divisions, the Division of Regional Economic Development and the Division of Economics. It coordinates the Management and Business Administration BA, the Regional and Environmental Economics MA courses and the Enterprise Development specialization in the old-system five year training.

In line with the teaching activity and the coordinated courses, the recent research interest of the Institute embraced three main fields: regional competitiveness and economic development, the regional aspects of innovation theory and policy and environmental sustainability. These research fields serve as a basis for the structure of present volume.

The first part of the volume is dealing with regional competitiveness and economic development and consists of five articles. Theoretical, methodological and policy issues are also embraced with a special focus on the present Hungarian challenges. The second part puts innovation in focus. The five articles of this part provide Hungarian empirical evidences about different aspects of innovation systems. The four articles of the third part, while focusing on sustainability, inevitably touch upon social issues.

The three main research fields that are embraced in the volume are not independent, which is well indicated by the large number of the co-authored papers. Innovation and technological change is often considered to be the basis of the long term competitiveness. However innovations induce change not solely in the economic sphere but also in social and environmental processes. On the other hand, a region can hardly be considered competitive or successful, if it is burdened by serious environmental problems, or its economic processes are environmentally or socially unsustainable.

We are grateful to Dolores Hofman and Miklós Lukovics for their selfless contribution and the management of the Faculty for supporting the realization of the volume.

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Bottom-up Regional Economic Development: Competition, Competitiveness and Clusters

Imre Lengyel

In the economies developing and transforming as a result of globalisation processes, increasing localisation represents one of the most marked processes: while the importance of national economies (relatively) is decreasing, the economic role of regions and cities seems to grow. Global competition has intensified also in space, especially with the growing importance of knowledge-based economy. Interregional competition, which means the competition of regions and cities for scarce resources, global aims and so on, is increasingly prevalent. The economic characteristics of interregional competition differ form those of the competition of companies or on the labour market; consequently, the improvement of competitiveness can be described differently in the case of regions.

After reviewing the most important features of global competition, the present paper provides a detailed analysis of the concept and characteristics of interregional competition. Departing from the criteria of interregional competition, it reviews the concept of regional competitiveness and gives the pyramidal model serving the improvement of regional competitiveness. Based on this model it also outlines the development ideas, so called 'UFO model', aiming to improve the competitiveness of regions with different development levels.

Keywords: interregional competition, regional competitiveness, cluster-based regional economic development

1. Introduction

Increasing regionalization represents one of the most spectacular processes of the economies that develop and transform as a result of globalisation processes: while the (relative) importance of national economies is decreasing, the economic role of regions and cities seems to grow. Global competition has intensified also in space, especially with the growing importance of the knowledge-based economy. Interregional competition, which refers to the competition of regions and cities for scarce resources, global aims and so on, is increasingly prevalent. The modes of improving regional competitiveness and the regional economic development strategies are heavily dependent on the type of the given regions.

Regional economic development strategies are especially important for the new member states of the EU, since between 2007 and 2013 they will receive significant subsidies from the European Union's regional development funds to improve the competitiveness of their lagging regions. The analysis of this issue calls

for clarifying various questions for the less developed regions. What do we mean by regional competitiveness and how can it be described and measured? Do the economic, social and institutional background and the cultural characteristics of a region influence regional economic development strategies? Which development strategy can most significantly improve regional competitiveness in the lagging regions?

After reviewing the most important features of interregional competition, this study provides a detailed analysis of the so-called "UFO model" serving as a cluster-based improvement of regional competitiveness. On the basis of this model we outline the regional economic development ideas aiming to improve the competitiveness of regions with different development levels. This model is suitable for the systematization of both top down regional policy and bottom-up regional economic development ideas, consequently it was also applied for the planning of the economic development strategies of the different region (nodal region) types of the Southern Great Plain region in Hungary.

2. New economics of competition

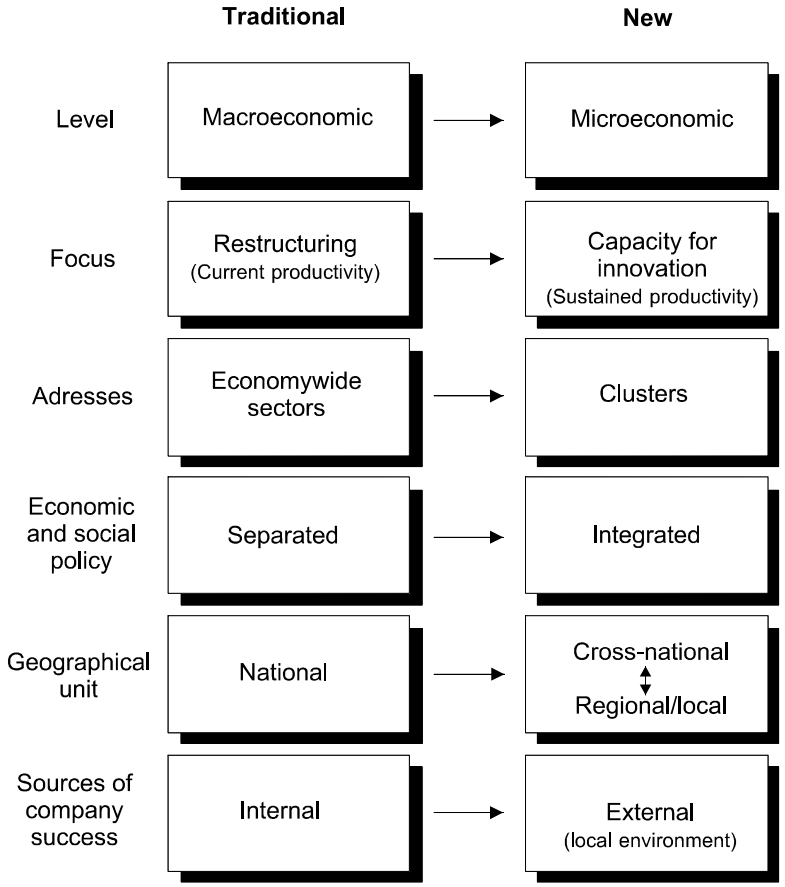
Globalisation has radically transformed the criteria and characteristics of market competition as well; the majority of new economic political answers and of the strategic answers of companies to newly emerging questions generated by global challenges depart from a novel understanding of competitiveness. As a result of global competition, the formerly characteristic territorial processes of the economy also changed; a 'global economy' is being shaped, where the former role of territorial levels undergoes reinterpretation. *Dicken* appropriately calls this newly emerging (world) economy 'new geo-economy', which is characterised by an increasing, unprecedented and intense unification process of economic activities; the world economy may be seen as a new organic unit of interconnected elements (Dicken 2003).

Intensifying competition, which characterizes the global economy, significantly shapes the theory and also the practice of regional economic development. This brings us to several fundamental questions. Is there interregional competition, and if yes how can it be characterized? Are lagging regions able to compete with developed ones, and what sort of strategy should they develop?

Market competition amongst companies can easily be interpreted, but it is questionable whether the long existing rivalry of countries and regions should be considered competition or not. Two opposing views exist in this respect. According to the first opinion, while in the case of companies the concept of market competition is unambiguous, in the case of cities, regions and countries it is impossible to talk about real competition. In the other view competition among regions and cities exists, but its features essentially differ form those of the market

competition existing among companies. The basic position of the trends departing from *comparative advantages* demonstrates the first approach well, while the schools accepting *competitive advantages* support the second one (Camagni 2002, Neary 2003, Pike et al 2006b, Sheppard 2000, Török 2006).

Figure 1. Transitions in competition



Source: own construction on the basis of Porter (2001, pp. 139-141.)

According to the theory of *comparative advantages*, if countries in international trade specialize in producing the goods and products, in which their relative labour productivity or their relative expenditure cost is more favourable, that leads to the development of an international division of labour, from which each country benefits (Krugman 1994, Krugman–Obstfeld 2002). This means that there is *no competition among countries* since free trade and the market automatisms governed by the 'invisible hand' generate a balanced development and create a favourable situation for each country that recognises its comparative advantages.

Therefore, it is useless to talk about competition among countries and to talk about competitiveness. Krugman's abovementioned thoughts are widely acknowledged and it has become commonly accepted in regional science that *the rivalry of countries and regions cannot be compared to companies' market competition* (Polenske 2004).

On the other hand, there is also relative consensus about the idea that there is not only rivalry among regions, but 'competition-like' features have also emerged: due to the effects of globalisation, the 'traditional' rivalry among cities, regions and countries has gained a new meaning by today (Begg 1999, 2002; Camagni 2002; Cheshire–Gordon 1998; Lever 1999; Malecki 2002, 2004).

The theory of *competitive advantages* reflects to the *new conditions of the global competition*. Michael Porter claims that today the theory of comparative advantages does not provide an acceptable explanation about the international division of labour (Porter 1990, 1998, pp. 322-324.). Porter's proposal to development is the *theory of competitive advantages*, which systematizes the development phases of countries and the new elements of the international (and regional) division of labour. The competitive advantage of a given country or region depends on economic structure, the development level of the institution system and the quality of its operation, governmental economic policies and ideas on regional development.

The competitive strategies of globally competing companies and the regional clusters exploit dynamic agglomeration economies. Defining the *new economics of competition*, Michael Porter (2001, pp. 139-141.) highlights six fundamental factors (Figure 1).

Formerly, the acting space of economic players and the conditions of competition were controlled mainly by macro-economic aspects like balanced budget, foreign trade balance, economic policies developed on the basis of inflation (monetary, fiscal, customs and industrial policies, etc). Today, however, economic growth and the development of a given country are primarily defined by *microeconomic bases* like the strategies of the dominant global companies and the local business environment. Obviously, governmental economic policies remain important but these have become highly similar in different countries (e.g. in the EU's member states) and their acting space has narrowed down due to the formation of global capital markets and the predominance of transnational corporations. The recognition of this has brought along a fundamental change in the economic policy of developed countries: instead of traditional investment promotion, industrial policy, infrastructural development, etc. that influence productivity merely in the short run, the main focus shifted to supporting the formation of a business environment that *improves innovation skills and capacity* by helping the business realisation of new ideas, the emergence of new lines of business and applying more effective company strategies. The improvement of productivity in a region depends

on what types of new goods are produced, which new market needs are satisfied and not on the more effective production of old products.

The new economic policy does not focus on economic sectors and large companies, the ownership and market relations of which it can hardly comprehend and influence, but rather on improving the sources of the competitive advantages of companies. These competitive advantages derive mainly from company collaborations and positive local externalities. Furthermore, they are highly specific depending on localness, which can be exploited in a flexible way only by *clusters, networks and SMEs*. Formerly, improving economic conditions was almost exclusively the task of economic policy, while social policy mostly dealt with 'spending' the budgetary earnings, and the institutions, their agents and ministries representing the two policies were also distinct. Today, *economic and social policies* must work together, the two are closely intertwined, therefore, need to set a shared objective: to improve the welfare of the local population. It is impossible to design separate economic and social policies because in case of differing objectives these weaken each other, which quickly leads to deterioration in the given country's position in global competition.

Nowadays, besides national economies (and partly instead of these), supranational economies crossing national economies (e.g. the EU) and (subnational) regional economies have become *dominant territorial units*. Partly related to this, the sources of the competitive advantages of global companies are mainly local and depend on the local environment, which means that the external economies of scale (local externalities, agglomeration advantages) and the overflow of knowledge have become important. The recognition, that *innovation processes* basically have 'double ties' partly depending on the local environment (the local innovation climate) and on global networks (mainly among knowledge creation city regions), also seems more and more common (Varga 2006).

The above-mentioned thoughts related to the new economics of competition cannot be regarded as fully mature, but should rather be interpreted as tentative proposals or research concepts (hypotheses). However, real economic processes more and more justify these observations and it seems that the traditional approach to competition fails to describe reality. The strong competition generated by globalisation processes and the changed economic circumstances force economic players to come up with new answers.

According to Porter (1996), regions do not compete with one another like national economies, which means that they do not use various governmental (monetary, fiscal, customs, export promotion, tax, investment and other) economic policies, since they do not even have such policies. But their competition is not similar to that of companies either, since there is no single decision making centre in the region that designs and executes a regional competition strategy by focusing on prifit maximizing. Regions and cities compete by creating a *business environment that fosters the productivity improvement* and contributea to the success of the

region's firms: specialised institutes of education, effective special infrastructure, information services facilitating innovation, enterprise-friendly administration, developing research and development institutes that meet the profile of clusters. Networks consisting of the various local groups (chambers, institutes, universities and so on) participate in creating the business environment.

3. Interregional competition

In connection with the territorial units we need to distinguish between competition among countries and among the different (sub-national) regions of a country. When analysing regional competition and competitiveness, Malecki (2002) underlines the fact that the regions seem to separate from the national economy more and more: today the development pace of the national economy depends on the economy of regions and cities as successful 'regional motors' and not vice versa. Companies can choose from a great variety of locations, therefore cities compete in 'attracting' the scarcely available profitable companies: not only financial benefits (tax discounts, promotion, etc.) but mainly the favourable business conditions (the quality of the infrastructure, the flexibility and standard of institutes in education, transparent legal regulations, etc.) are the decisive factor in the competition. „In short, competition among cities is real and has become 'fiercer'" (Malecki 2002, p. 930.). Interregional competition is a special type of competition that can be characterised with easily producible parameters and regional competencies (Budd–Hirmis 2004).

In the competition among the different regions within a country *scarcity* derives from two interrelated factors: investments made in the new market segments demanding special expertise and talented experts (Malecki 2002, p. 930.). The competition of regions is a skill 'sticking' or attracting investments and talented labour force and the main goal is "to sustain their attractiveness to both labour and capital" (Markusen 1999, p. 98). Not only the attraction of capital and creative employess from outside the region is necessary, but the attraction of tourists as well, and the local entrepreneurial skills also need stimulation. The results of interregional competition are similar to those of the competition among countries: in the successfully competing regions thewelfare (living standard) improves, employment and incomes (wages) are high, new investments take place, talented young people and successful businessmen move there, etc. (Malecki 2004, Polenske 2004).

Based on the abovementioned features the *definition of interregional competition* may be conceptualized as the following (Cheshire 2003, Cheshire–Gordon 1998, Gordon–Cheshire 2001, Lengyel 2003a): a *process that occurs among territorial units aiming to increase the welfare of the people living in the cities or regions by promoting the development of regional and local economy, a development that certain groups try to influence explicitly or often implicitly through local policies by competing and rivalizing with other territorial units.*

The definition of interregional competition described above is relatively general and can be interpreted for a wide range of territorial units. Taking into account also the practical characteristics of interregional competition, the following factors are important in interpreting the definition (Lengyel 2003a):

1. The *aim* of interregional competition is to improve the welfare of the population living in the region, what calls for the permanent increase of the income produced there. This income is distributed to a wide range of the local population especially through a high rate of employment.
2. The *players* of interregional competition are the territorial units: regions and cities, the interests of which are represented by *local groups* often competing with one another. Besides the local government, city council and its institutions, the representatives of the *local economic scene* and *civil sphere* are also involved jointly constituting a so-called regional network. The (city or county) *local government's coordinating* role is indispensable in this network.
3. We can only talk about interregional competition in case of a *bottom-up* regional and local economic development, when the local players design and implement their competition strategy independently.
4. The main instrument of interregional competition is the development and implementation of *local economic development ideas* facilitating the economic development. The creation of a business environment that generates an improvement in the income generating capacity of the local economy is obviously essential. The city or region's vision of future together with the ideas that lead to it must be made public so that enterprises and households can make their decisions (of implicit effect) with awareness.
5. Interregional competition is a *process*, which means that it has a dynamic approach and needs adaptation to constant changes. Therefore, it is necessary to rephrase actual goals regularly and shift focus among local groups based on which of them can best achieve the realization of these goals.
6. Interregional competition occurs primarily among the territorial units of the *same hierarchical level* (NUTS-system) and in the same competitive phase, so among cities or regions of similar development level and size. Therefore, an industrial region, for instance, is not a direct competitor of an agrarian region or a city region operating as a logistics-financial centre. Indirect competition among regions at different development levels also occurs but only temporarily, for the duration of certain projects.
7. Interregional competition *does not zero-sum game*, which means that winners do not necessarily gain advantages to the disadvantage of losers; instead, economic development is possible in each region or city simultaneously. Consequently, besides competition, conscious cooperation and harmonized development strategies (e.g. an airport in case of a larger scale infrastructural

investment) may prove beneficial, especially among neighbouring territorial units.

8. Beyond a conscious development strategy, interregional competition may also be influenced by *implicit (indirect)* developments not included in community programmes and unforeseeable synergic effects, especially the consequences of the decisions made by enterprises and households.

It is essential that interregional competition mostly occurs *based on economic aspects* and the major goal of the players participating in the competition is to generate a long-term and stable increase in the income of the region or city, that is, successful economic development. A region or city does not participate in this competition as a whole, but is divided in *various interest groups* often with conflicting interests.

The *results of interregional competition* are similar to those of the competition among countries: in the region successfully competing welfare (living standard) improves, employment and incomes (wages) are high, new investments take place, talented young people and successful businessmen move there, etc. (Camagni 2002, Malecki 2004). Naturally, in the less successful regions just the opposite occurs: welfare (living standard) deteriorates or stagnates, incomes fail to increase, there is a reduction in the number of work places, no new investments occur, unemployment increases, talented young people and successful businessmen leave, the population grows older, etc. However, contrary to company competition the results of interregional competition become apparent slowly, usually after long decades, especially owing to the low mobility of households.

Summarizing the competition among regions: it occurs with economic goals to achieve the constant improvement of welfare (living standard). In this competition regions compete by creating a business environment calculable and attractive for companies, by attracting or keeping successful enterprises and talented labour force. Each region must develop a *bottom-up competition strategy*: they must design a vision of future, concept and programmes and achieve wide public awareness this way orienting the local population, the inhabitants and enterprises excluded from active regional networks (Rechnitzer 1998). Regions can only be successful by actively implementing a bottom-up development strategy that departs from a widely accepted vision of future and harmonizing projects that have different economic development effects with the help of dynamic regional networks.

4. UFO model: cluster-based regional economic development

Successfulness in competition, or in other words, *competitiveness* has been one of the key concepts often used and quasi ’fashionable’ in many areas of economics over the past two or three decades partly due to the acumination of global

competition. It is a fashionable term the use of which seems nowadays to be nearly obligatory. In Iain Begg's apt formulation: "improved competitiveness, as we all know, is the path to economic nirvana" (Begg 1999, p. 795.).

The objective of regional and local economic development is the improvement of the standard of living and quality of life of the region's inhabitants. Hence economic development and competitiveness are strongly connected, only those kinds of programmes belong into the competence of economic development which improves regional competitiveness.

Two major issues emerged in the debates aiming at the interpretation of competitiveness: on one hand, *how to define regional competitiveness and what indicators should be used to measure it*? On the other hand, *how can regional competitiveness be improved*, which governmental and local interventions may be regarded as successful? These two questions usually lie in the background of other professional debates too; while representatives of academic economics concentrate on the first one, experts of regional policy tend to focus on the second one.

There were a number of attempts to define the new notion of competitiveness according to new global competition conditions in the mid 1990s. The standard notion of competitiveness *in the Sixth Regional Periodic Report of EU* (EC 1999): *'*The ability of companies, industries, regions, nations and supra-national regions to generate, while being exposed to international competition, relatively high income and employment levels*'. In other words 'high and rising standards of living and high rates of employment on a sustainable basis'* (EC 2001). *In the European Competitiveness Report* (EC 2008, p. 15.): *"Competitiveness is understood to mean a sustained rise in the standards of living of a nation or region and as low a level of involuntary unemployment, as possible." In the report of Regional Competitiveness Indicators of UK* (DTI 2002): *'Regional competitiveness describes the ability of regions to generate income and maintain employment levels in the face of domestic and international competition'*.

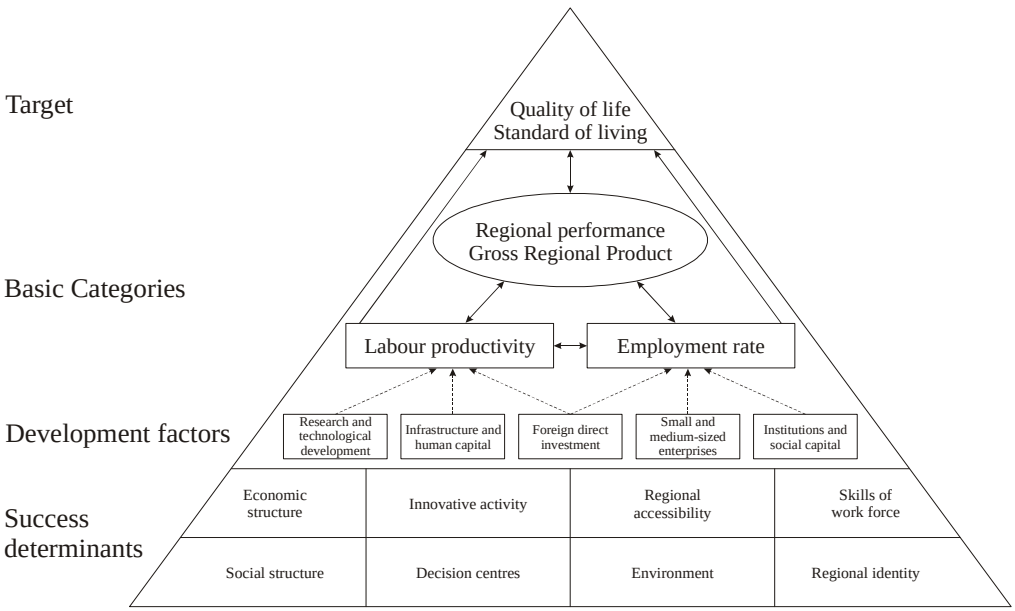
Hence the *substance of regional competitiveness*: the economic growth in the region, which growth is generated by both a *high level of labour productivity* and a *high level of employment*. In other words, competitiveness means *economic growth driven by high productivity and a high employment rate*.

The notion of competitiveness obtained in this way cannot be used, however, to identify factors responsible for regional competitiveness or areas which are to be strengthened or developed by regional development policies and programmes for improved competitiveness. Since the notion of competitiveness can be seen as refining that of economic growth, it can often be observed that proposals for improved competitiveness combine traditional means of economic development with methods based on endogenous development.

The *pyramidal model of regional competitiveness* seeks to provide a systematic account of these means and to describe the basic aspects of improved competitiveness (Figure 2). 'This model is useful to inform the development of the

determinants of economic viability and self-containment for geographical economies' (Pike et al 2006a, p. 26.). 'This is an aggregate notion, …, in a regional context, labour productivity is the outcome of a variety of determinants (including the sort of regional assets alluded to above). Many of these regional factors and assets also determine a region's overall employment rate. Together, labour productivity and employment rate are measures of what might be called 'revealed competitiveness', and both are central components of a region's economic performance and its prosperity (as measured, say, by GDP per capita), though obviously of themselves they say little about the underlying regional attributes (sources of competitiveness) on which they depend' (Gardiner et al 2004, p. 1049.).

Figure 2. The pyramidal model of regional competitiveness



Source: Lengyel (2000, 2004)

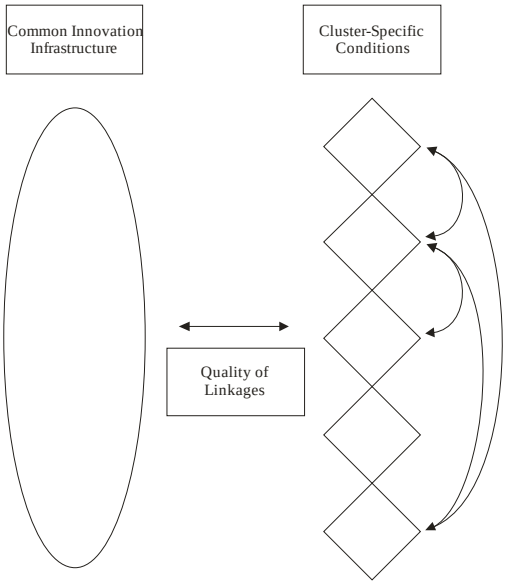
The standard of living, prosperity of any region depends on its competitiveness (Begg 2002). Factors influencing regional competitiveness can be divided into two groups of *direct* and *indirect* components. Of particular importance are programming factors with a direct and short-term influence on economic output, profitability, labour productivity and employment rates (Huggins 2003, Lengyel 2004). But social, economic, environmental and cultural processes and parameters, the so-called 'success determinants', with an indirect, long-term impact on

competitiveness are also to be taken into account (Enyedi 1996, Jensen-Butler 1999).

The elements of regional competitiveness are systematized by the pyramidal model, which reduces the components of economic development to connected factors (Enyedi 2009, Pike et al 2006b). Can competitiveness be improved by developing the same factors in all kinds of regions? What determines the success a regional development strategy?

The vitality of regional development strategy in a region is depend on regional innovative capacity. 'This capacity is not simply the realized level of innovation but also reflects the fundamental conditions, investments, and policy choices that create the environment for innovation in a particular location" (Porter–Stern 2001, p. 5.). The regional innovative capacity depends on three broad elements: common innovation infrastructure, cluster-specific conditions, and quality of linkages (Figure 3). Porter has argued that traded regional clusters are capable of improving competitiveness and therefore proposed a cluster-based approach to regional economic development (Porter 2003b).

Figure 3. Elements of regional innovation capacity



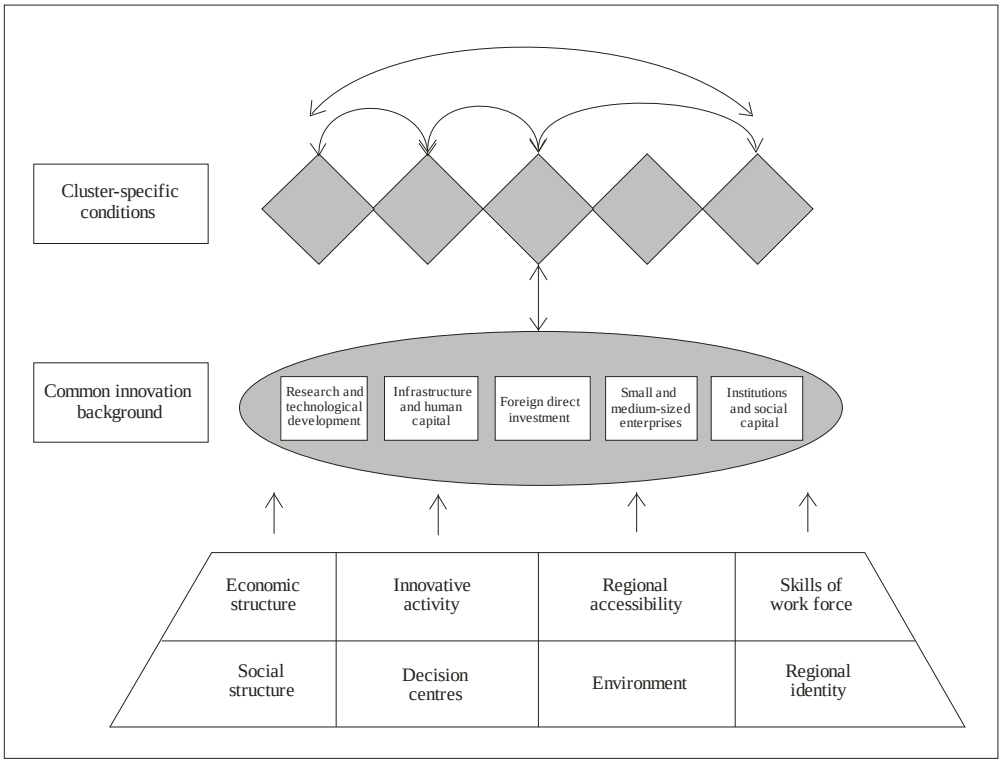
Source: Porter–Stern (2001, p. 5.)

In line with the structure of the pyramidal model and element of regional innovative capacity, we distinguish between four levels of bottom-up regional economic development programmes aiming to improve regional competitiveness (*Figure 4*): success factors, common innovation background, cluster specific

conditions, and linkages. While on the basis of the pyramidal model the competitiveness can be measured and the influencing factors can by systematized, cluster-based development enhances the basic industries of the regions, an by doing so it reinforces specialization necessary for meeting the challenge of global competition.

On the basis of *UFO model* (*U*nconventional *F*ramework of *O*perational programming) we outline the regional economic development ideas aiming to improve the competitiveness of regions with different development types. The UFO model suitable for the systematization of both regional planning and cluster-based regional economic development ideas, consequently it can be also applied for the planning of the economic development strategies of the different subregion (nodal region) types.

Figure 4. UFO-model: the structure of bottom-up regional economic development



Source: own construction

Four levels of UFO model can be distinguished with regard to the objectives of regional development strategies and the various characteristics and factors influencing regional competitiveness (Figure 4):

- *Success determinants*: on the basis of the pyramidal models, the reinforcement of certain absent or weak background conditions of region's economy, which are the bottlenecks of regional development. Regarding these actions interregional competition does not emerge, fundamental public utilities and amenities must be guaranteed in the least developed regions as well. Thus within the meaning of cohesion all the regions must be supported that are in need.
- *Common innovation background*: such programmes aiming at the improvement of regional competitiveness, systematized on the basis of the development factors of the UFO model, that further the reinforcement of most of the industries' and enterprises' competitive advantages in the regions. The regional development strategy of the common innovation background depends on the development/competitive type of the region (see next shapter). In connection with the improvement of the common innovation background interregional competition can be observed among the similar regions. This is why the regional organization of bottom-up economic development is important, in order to support solely those regional programmes and projects that are able to improve regional competitiveness the most.
- *Cluster specific conditions*: in more regions it is possible that innovative clusters will emerge. In other regions the emergence of manufacturing and tourism clusters can be expected. Clusters generate very intense interregional competition. To develop similar industries are endeavoured also in other regions of the country, therefore only those regional economic development strategies will be able to succeed that are based on regional consensus and unity and that aim to improve the competitive advantages on the given industry's enterprises.
- *Linkages*: it is essential that there should be interdependence between programmes aiming to improve the common innovation background and clusters, because only this approach can result in the development of regional competitiveness.

The UFO model can successfully be applied as a demonstration shame in purpose of systematizing development programmes of regions for improving regional competitiveness. Because of the interregional competition, however, in the nodal regions cluster-based programmes must also be developed and constantly managed with the involvement of the concerned enterprises.

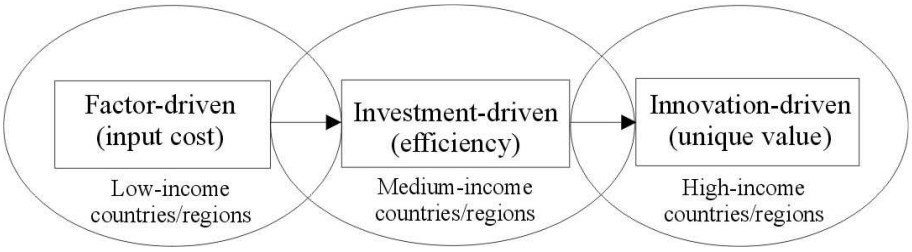
5. Competitive regional development

Different 'market places' also occur in the global competition of countries, regions and cities. *Tödtling and Trippl* (2005, p. 1209.) describe three types of regions by

problem areas and regional innovation deficiencies: peripheral region (organisational thinness), old industrial regions (lock-in), and fragmented metropolitan regions. In 2003 one of the research projects of the EU analysed the factors influencing regional competitiveness and how dominant the elements determining competitiveness are in different region types in order to create the foundation of regional policy between 2007 and 2013. During the research four 'theoretical' region-types were distinguished based on two dimensions, density of population and the growth rate of GDP (Martin et al 2003 p. 6-23.): non-productive regions, regions as production sites, regions as sources of increasing returns, and regions as hubs of knowledge.

Based on the characteristics of *competitive advantages*, Porter (2003b) distinguishes three stages in the countries' development built upon one another. On the basis of the amount of specific GDP and the competition strategies of global industry branches these are (Figure 5): factor-driven, investment-driven and innovation-driven phases. The three phases of competitive development designed for countries can also be applied in the case of regions (Lengyel 2003a). And these types are very useful to underlie the bottom-up regional development strategies of the regions.

Figure 5. Stages of competitive development of countries/regions



Source: own construction on the basis of Porter (2003b, pp. 26-28.)

The division of labour among the subnational regions of a country is different from that of different countries. A region cannot develop own economic policies; instead, its economy specializes as a consequence of market processes and central governmental development decisions. Nowadays, *knowledge-based economy* strongly shapes the specialization patterns of a country's regions with different development levels, and also changing the former characteristics of interregional competition (Grosz et al 2005, Lengyel–Leyesdorff 2010). Consequently, the three phases of competitive development should be specified based on the processes of the knowledge-based economy by using the specialisation of the *postfordist economy* (Cooke 2001, Lengyel 2003a).

Based on the differences among regions it is preferable to differentiate where knowledge is created and where it is only adapted (Asheim 2001, Bajmócy 2006,

Lengyel B. 2005). In the case of competitive regional development only in the innovation-driven phase can it be stated definitely that competitive advantages derive from knowledge creation, while in the investment- and factor-driven phases they originate from the mere adaptation of knowledge. Less developed, lagging regions are in an exposed situation, certain features of the knowledge-based economy are present, but *neofordist characteristics* are decisive (Lengyel 2003a).

In harmony with the phases of competitive development *three types of postfordist regions* must be distinguished (Asheim 2001, Lengyel 2003a, Martin et al 2003):

- *Neofordist region*: factor-driven phase (regions with low income and input cost), regions as production sites,
- *Knowledge transfer region*: investment-driven phase (regions with medium income and efficiency), regions as sources of increasing returns, and
- *Knowledge creation region*: innovation-driven phase (regions with high income and unique value), regions as hubs of knowledge.

Neofordist and knowledge transfer regions differ from knowledge creation regions not only in terms of the sources of competitive advantages, but also because they are economically exposed and fragile, first of all in the transition economies (Enyedi 1996, Papanek et al 2008, Rechnitzer 2000). The decision centres of global companies hardy occur in less developed regions, so they demand knowledge less; rather the executive type activities of global companies are present here. Besides assembly plants, units of global companies selling products and performing service activities on the local market, local branches of international banks and insurance companies, and sometimes subsidiaries engaging in minor research activities also operate here. Naturally, most regions are 'mixed', but while neofordist and knowledge transfer activities and companies also exist in knowledge creation regions, the number of firms based on knowledge creation is close to zero in neofordist regions (Lengyel 2003b).

In the course of the debate on interregional competition, it is increasingly acknowledged, that regions with similar state of development compete with each other, while amongst the different types of regions there is rather rivalry (Camagni 2002, Malecki 2004, Polenske 2004, Hall 2001). Competition is especially intense among metropolises, but within the EU or a country there also exist interregional competition amongst nodal regions with similar state of development.

Concerning the three region types reviewed above, different development strategies must be applied, which means that *the improvement of competitiveness demands different measures based on the different types of regions*. These steps correspond to the phases of competitive regional development and at the same time indicate that competitiveness can be improved only with the help of complex programmes. The UFO model systematizes those economic development priorities that adjust to the real social-economic situation and the achievable (realistic) aims of

the different region types. The improvement of regional competitiveness depends on the consistent realisation of these development strategies.

6. Bottop-up economic development with different types of regions

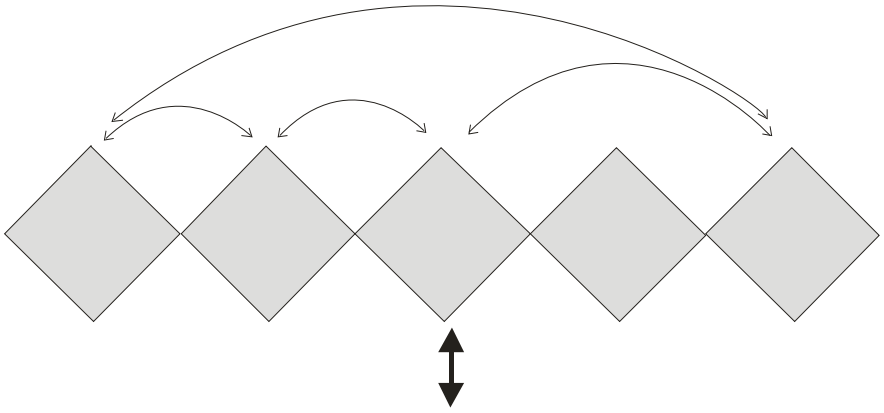
In the course of describing the features of interregional competition we emphasised that those regions compete with one another that have similar economic structure and are at the same level of development. At the same time, it is not enough to measure the competitiveness of regions, but we also need to outline what can be done to improve competitiveness. Furthermore, a special version of the UFO model can be designed, the elements of which are built upon the real opportunities of the given region type and may contribute to improving the competitiveness of the region. The elements of the common innovation background (basic factors of pyramidal model) are different in each sub-type.

The *neofordist region* is underdeveloped, it corresponds to a semi-periphery, the generated income (GDP/habitant) is low, and the economy is typically in the factor-driven phase. The development of infrastructure is insufficient, the education level of the labour force is low, the members of company management are not competitive internationally and part of the qualified labour force and talented young people leave the region (Lengyel 2002). The major goal focuses on developing the technical infrastructure (transportation network, energetics, etc.) and attracting the sites of global companies with prepared industrial areas, low local taxes, low wages, etc.

Local companies do not need *research & development* in neofordist regions, but as already mentioned, all of them purchase older technologies from abroad (Figure 6). Therefore, these companies do not have R&D units and they are not closely linked to development institutions either. Since there are no local company assignments, local university research and the related laboratories and equipment must be financed from governmental funds. In such regions support should target basic research, especially at local universities, and certain outstanding research laboratories to solve minor applied R&D tasks.

Regarding the elements of *infrastructure and human capital* as development factors, such regions should concentrate on developing the transportation networks that are usually less established and of low quality. Mainly motorways, airports, railroad systems, ports, logistic centres must be created that are essential for making the divisions of global companies targeting cost advantages settle. It is also advisable to design industrial areas (industrial parks) containing concentrated infrastructure, partly owing to environmental reasons. Vocational training cannot be transformed based on special company needs, but rather the quality of task-oriented schemes offering wide basic training in existing institutes must be improved.

Figure 6. Bottom-up economic development of neofordist region



Research and technological development	**Infrastructure and human capital**	**Foreign direct investment**	**Small and medium-sized enterprises**	**Institutions and social capital**
- Non-business and governmental R&D - Separated R&D - Laboratories, equipments	- Industrial parks - Transportation networks - Vocational training	- Locations of companies - Satellite platform district - Local business relations	- Networks of suppliers - Financial promotion - Entrepreneurial skills	- Enterprise-friendly administration - Business and technical higher education - Ability for local cooperation
Neofordist region				

Source: own construction

In the case of *investments coming from outside the region*, the divisions of companies must be attracted that are able to generate regional multiplicator effects by establishing a new activity. In the region these divisions and activities can work as the starting points of a structural change, which the local economic sphere is unable to achieve by itself. The embedment of global companies' divisions, the development of local business and personal relations must be encouraged with the help of various events, forums to enable information flow that can also be followed by business transactions later on.

In neofordist regions very few *small and medium-sized enterprises (SMEs)* are present in the traded sector, neither the business environment, nor the preparation level of these companies is enough for global competition. SMEs have insufficient international knowledge; therefore, the wide dissemination of modern entrepreneureal skills and enterprise culture is essential for their development. This should be understood as a *learning process*, SMEs can learn not only at courses but also from one another and from global companies too. One of the most important objectives is for SMEs to become the business partner or contracted supplier of

settled global company units, because this way they can win a stable market and gain modern knowledge and business experience.

In a neofordist region the *institutions and social capital* are not market-friendly enough. Public administration organisations must be made to have 'enterprise-friendly' customer services. As for training programmes available in higher education institutions, the technical, business, economic training necessary for the successful operation of enterprises is either missing or is of poor quality, so support must be lent to launch, strengthen and disseminate these programmes, so that modern business training can become part of the curriculum in each higher education scheme.

Knowledge transfer regions are usually medium developed, the most important goal of economic development lies in continuing the structural change by keeping existing companies and creating work places with higher added value. These regions are in the investment-driven phase, they have traded large companies with local headquarters, which already have a network of local SMEs as their contractors. Transportation infrastructure is developed; therefore, the *improvement of the local business environment* is in focus. The education level of the labour force and the training structure already correspond to the needs of the economic sphere, retraining programmes and courses to improve managerial skills are frequent (Lengyel 2009).

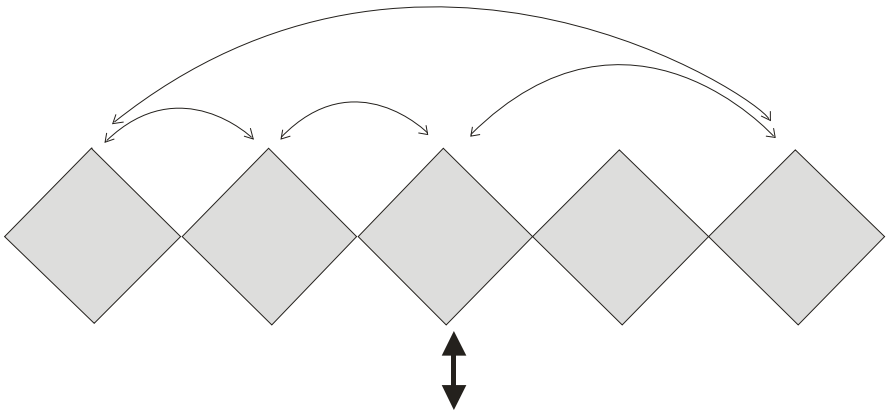
In knowledge transfer regions the need for *research & development* has already emerged, local traded companies also create development units assigning an increasing number of applied research part-tasks to local development companies and research institutes (Figure 7). In the course of economic development, the harmonised research and development activity of companies and institutes must be encouraged. In order to assist smaller companies the establishment of agencies, institutes and other bodies dealing with technology transfer must be facilitated.

Infrastructure and human capital are relatively developed and the transportation network has been established. Support must focus on the institutions and agencies of the business infrastructural background (training institutions, consulting companies, etc.) that satisfy actual company expectations. In harmony with the emerging R&D needs, institutions contributing to the improvement of innovation capacity (innovation centres, incubators) must be created (Bajmócy et al 2007). Strengthening local strategic industry sectors can define their needs precisely concerning the qualification of the labour force, so special training programmes related to these must be developed.

Among the *investments coming from outside* knowledge transfer regions, only those need promotion, whose activities are in harmony with the developing regional strategic industry sectors already present. The embedment of companies with bases outside the region must be encouraged by increasing the circle of SMEs acting as local contractors. This way more and more elements of the global companies' value

chain can be present in the region, what not only stimulates the economic growth, but also helps to improve employment.

Figure 7. Bottom-up economic development of knowledge transfer region



Research and technological development	**Infrastructure and human capital**	**Foreign direct investment**	**Small and medium-sized enterprises**	**Institutions and social capital**
- Applied R&D - Coordinated R&D - Technology transfer	- Innovation centres, incubators - Business infrastructure - Task-oriented vocational trainings	- Supported investments - Satellite-Marshallian industrial district - Local value chains	- Horizontal networks - Business services for start-up - Trainings for managers	- Decentralized administration - High education by local business needs - Non-profit organisations
Knowledge transfer region				

Source: own construction

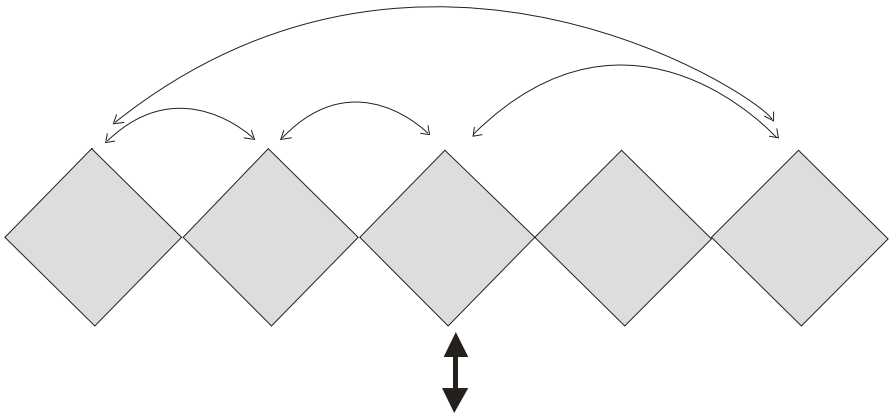
In knowledge transfer regions more and more *small and medium-sized enterprises* (SMEs) operate in the traded sector, and are prepared for global competition. In order to strengthen these SMEs, the development of their horizontal networks, clusters must be helped. The formation of start-up companies related to the activities of developing strategic industry sectors must also be encouraged mainly with business incubator programmes.

In these regions the role of *institutions and social capital* is increasingly important. Fast and reliable public services are essential for the successful global competition of developing strategic industry sectors and strengthening SME networks. Therefore, it is necessary to decentralise administration, since only regional and local governments present in the region can take measures effectively and flexibly. Local higher education must be encouraged of design training modules

corresponding to the labour force needs of strengthening local strategic sectors this way ensuring the prepared labour force supply for companies.

In knowledge creation regions economic output is high, these regions are in the innovation-driven phase and the regional centres of significant global companies are situated here. Administration is decentralised, a cluster-based economic development is set as an objective partly due to this to improve the business environment necessary to strenghten the competitive advantages of global companies with local headquarters. Developing the background of innovation capacities is in focus, scientific parks, universities, incubator programmes, venture capital and other schemes have an important role.

Figure 8. Bottom-up economic development of knowledge creation region



Research and technological development	**Infrastructure and human capital**	**Foreign direct investment**	**Small and medium-sized enterprises**	**Institutions and social capital**
- Harmonised business and non-business R&D - Integrated R&D - Innovative milieu	- Science parks - Communications networks - Problem-oriented trainings, retrainings	- Attracting decision centres - Hub-and-spoke district - Local supporting and related industries	- Clusters - Venture capital - Business incubators for spin-off	- Collaboration among administration and businesses - Cluster-oriented high education - Regional identity
Knowledge creation region				

Source: own construction

In knowledge creation regions *research & development* is of high quality, governmental and business R&D performs harmonised research based on the needs of clusters (Figure 8). The innovation environment is developed, the institutional

system and the local society equally place emphasis on supporting collaboration in the frameworks of research programmes (Török 2006, Varga 2009).

Infrastructure and human capital equally follow innovation expectations. Transportation and business infrastructures are developed, the most important objective lies in improving the scientific infrastructure: to establish scientific parks and communications networks. In the traded sector vocational training, especially retraining must shift from task-oriented to become problem-oriented, since more and more innovative experts are needed who are able to make individual decisions and perform work independently.

Among investments coming from outside the region the most important effort targets attracting the decision centres of international and governmental organisations and global companies. The settlement of supporting and related industries must be encouraged in order to strenghten clusters. To improve employment, support must be lent to cooperations among SMEs and global companies with local headquarters.

The rate of *small and medium-sized enterprises* of traded nature is high, their competitive advantages must be strenghtened by creating clusters. The growing number of innovative SMEs demand various forms of venture capital, therefore, it is important to encourage the creation of such services. Spin-off companies departing from universities and employing creative graduate and doctoral (Ph.D.) students and young lecturers must be assisted with different incubator programmes.

The *institutions and social capital* equally support cluster-based economic development. Higher education satisfies the needs of local strategic sectors and clusters striving to launch training and research programmes of high scientific quality. Regional networks operate effectively and regional identity is strong. Mechanisms have been developed to handle conflicts emerging in the collaboration of the various organisations of the decentralised administration and the private sector, the local economic governments and non-profit organisations.

Concerning the three region types reviewed above, different economic development programmes must be applied, which means that *the improvement of competitiveness demands different strategies based on the different types of regions* (Table 1). These steps correspond to the phases of competitive regional development and at the same time indicate that competitiveness can be improved only with the help of complex bottom-up programmes. The UFO systematises those economic development priorities that adjust to the real social-economic situation and the achievable aims of the different types. The improvement of regional competitiveness depends on the consistent realisation of these development programmes.

Every contry is heterogeneous, since it consists of subnational regions with significantly different state of development. Due to the strong interregional competition, bottom-up strategies must be developed in all regions. These should refer to reinforcement of clusters beside the common innovation background. This is

the only way that provides an opportunity for the improvement of regional competitiveness.

Table 1. Elements of common innovation background of the distinct types of regions

	Research and technological development	**Infra-structure and human capital**	**Direct investment outside from region**	**Small and medium-sized enterprises**	**Institutions and social capital**
Knowledge creation	Harmonised business and non-business R&D Integrated R&D Innovative milieu	Science parks Communi-cation networks Problem-oriented trainings, retrainings	Attracting decision centres Hub-and-spoke district Local supporting and related industries	Clusters Venture capital Business incubators for spin-off	Collaboration among administration and businesses Cluster-oriented high education Regional identity
Knowledge transfer	Applied R&D Coordinated R&D Technology transfer	Innovation centres, incubators Business infrastructure Task-oriented vocational trainings	Supported investments Satellite-Marshallian industrial district Local value chain	Horizontal networks Business services for start-up Trainings for managers	Decentralized administration High education by local business Non-profit organizations
Neofordist	Non-business and governmental R&D Separated R&D Laboratories, equipments	Industrial parks Transportation networks Vocational training	Location of companies Satellite platform district Local business relations	Networks of suppliers Financial promotion Entrepreneuri al skills	Enterprise-friendly administration Business and technical higher education Ability for local cooperation

Source: Lengyel (2003a)

7. Summary

This study reviewed the most important questions related to interregional competition and regional competitiveness. Globalisation processes, their interregional characteristics and global competition lead to the development of a ’new economic space’. With the emergence of the knowledge-based economy the international division of labour also transforms and the role of regions in the

postfordist economy must be reconsidered. Three basic region types can be distinguished that participate differently in the international division of labour. The acceleration of global competition has resulted in the increase of competition among regions, or more precisely, nodal sub-regions.

Due to the special characteristics of global competition, the concept of regional competitiveness must also be defined. There is abundant literature on competitiveness with certain well-known approaches, out of which especially the concept of standard competitiveness common in the European Union seems adequate in case of the regions not only for scientific analyses but also for regional economic political applications. The concept of standard competitiveness is partly linked to the thought of economic growth; therefore, it also leans on theoretical economics, although it also has strong regional political and economic development aspects that brings it close to the questions of business sciences as well.

For the interpretation of regional competitiveness a pyramidal model was established that offers a complex frame for the measurement and improvement of competitiveness. It does not only make a proposal concerning the indicators applicable for measuring competitiveness, but also systematises economic development ideas depending on the types of regions. The logic of bottom-up regional economic development is demonstrated by the UFO model, which connects the approach of competitiveness and the practice of cluster development in the different types of regions.

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Measuring Regional Disparities on Competitiveness Basis

Miklós Lukovics

Several economic theories and empirical analyses have been put forth about the nature and principles of regional disparities. Analysts often apply GDP per capita, as a quasi absolute indicator to explore regional disparities, albeit spatial processes have become more and more complicated and complex in the globalized economy. Parallel to the catching-up process of the countries at the national level, there is another spectacular process at the regional and local level: regional disparities are widening because the growth of the most developed sub-regions is increasing while the less favoured sub-regions are lagging behind. Consequently, regional analyses must devote increasing attention to studying sub-regions.

The present paper is aiming to develop a complex method on analyzing regional disparities, based on the notion of regional competitiveness and its closed logical system, correctly chosen theoretical model (the pyramidal model of regional competitiveness) and statistical data. To carry out the analysis, I use K-means cluster analysis, and its output. This is the first time ever that this has been used for this purpose.

Keywords: regional disparities, Williamson-hypothesis, regional competitiveness

1. Introduction

Economic, social and territorial cohesion are increasingly important segments of the European Union's regional policy, deriving from the history of the European integration: "*The Community shall have as its task […] to promote throughout the Community a harmonious, balanced and sustainable development of economic activities"* (EC 1997, Article 2). According to the Treaty of Lisbon, the Union shall promote economic, social *and territorial* cohesion, instead of the former terminology: economic and social cohesion (EC 2007).

At the time of the signing of the Treaty of Rome (1957), there had not been a declared common regional policy, the treatment of regional inequalities started at the national level in the 1960s (Rechnitzer 1998). The multi-step enlargement process of the European Union, and particularly the joining of the Mediterranean countries resulted in deepening spatial inequalities in the European Economic Area.

This, together with the effect of globalization, which increased the importance of locations, made the community-level regulation of the problem inevitable. The article 130 of the 1987 Single European Act declares the main objectives of the common regional policy, out of which the aim of "*reducing disparities between the*

various regions and the backwardness of the least-favoured regions" excels (EC 1987). After forming the central fund system of Structural Funds[1] to treat regional disparities on the basis of uniform principles at the end of 1980s, the Treaty of Maastricht unfolded the concept of cohesion: economic convergence and social cohesion (EC 1992).

The Treaty of Amsterdam devotes a distinct title (XVII.) to economic and social cohesion: "*in particular, the Community shall aim at reducing disparities between the levels of development of the various regions and the backwardness of the least favoured regions or islands, including rural areas*" (EC 1997, Article 158). The European Spatial Development Perspective approved in 1999 mentions economic and social cohesion as one of its three main objectives (EC 1999).

The forth cohesion report is already talking about "*economic, social and territorial cohesion*" (EC 2006), and by doing so it highlights an important problem. Namely after the 2004 enlargement serious territorial disparities characterize the whole European Union regarding both output, productivity and employment.

It is also an essential mega-trend that nowadays the local level is sensibly gaining importance as a territorial level that houses core-competences, where the long-term competitive advantages of firms are concentrated, and where local actors are able to give effect to their economic development conceptions. The primary analytical unit of economic advantages is therefore the local unit where one can change their workplace without changing their domicile (Lengyel 2003).

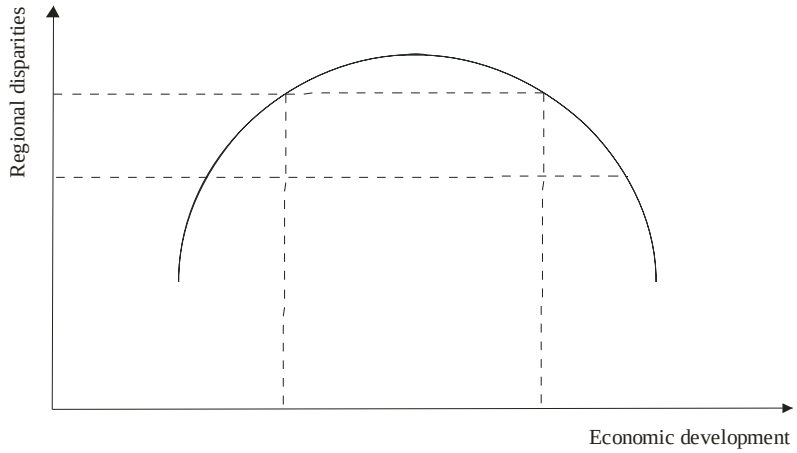
In the present paper, by responding to the above mentioned challenges, we attempt to introduce such an analytical method that is able to detect territorial disparities *of the local level in their complexity, using a multi indicator based approach*. Before this we gain insight into the background of the conventional *single indicator-based* analyses. But first of all we review the *relevant economic theories* that are needed to understand the nature and change of territorial disparities.

2. The nature of territorial disparities' evolution

Despite the fact that the multi-step enlargement of the European Union has drawn attention to regional policy's need for concentrating significant resources to reduce territorial disparities, we must consider the economic regularity well-known as Williamson-hypothesis, which says that *territorial disparities will grow until a certain state of development* (Figure 1). According to Williamson's concept that was put forth in 1965 economic growth first induces regional divergence and in the later phases convergence (Kiss–Németh 2006, Davies–Hallett 2002, Szörfi 2006, Nemes Nagy 2005).

[1] The common denomination of the European Social Fund, the European Agricultural Guidance and Guarantee Fund, Guidance Section, the European Regional Development Fund and the Financial Instrument for Fisheries Guidance.

Figure 1. Williamson curve



Source: Davies–Hallett 2002, Nemes Nagy 2005

In connection with the Williamson-hypothesis we must note that its consequences are inconsistent with the conceptions of certain theoretical schools, moreover the convergent phase of the Williamson curve can be *interpreted in different ways* within the conceptual background of the distinct bodies of theorizing. Zsolt Fenyővári and Miklós Lukovics (2008) reviewed eight theoretical schools in order to examine – among others – the occurrence of territorial convergence within the given theoretical interpretations[2] (Fenyővári–Lukovics 2008):

1. In the *classical economic theory* the efficiency advantages of the regions deriving from the comparative specialization will eventually contribute to the reduction of territorial disparities in a way that is advantageous for all the participating regions.
2. In the *neoclassical economic theory*, due to the presumption of the absolute mobility of the factors of production (including technology), all the inequalities in the model – embracing any kind of developmental disparities between regions – decease in the long run.
3. In the *Keynesian economics* the reduction of regional disparities can not be interpreted as the result of spontaneous market processes. The desirable processes are much more linked to the result of certain intended institutional interventions.
4. *Endogenous growth theory* interprets the productivity growth as an outcome of the spatial diffusion of knowledge and technology, which does not infer any automatism for the reduction of territorial inequalities. However the regional (economic) policy aiming at the deliberate development of the

[2] Similarly, the research of Málovics and Ván (2008) examined the connection between the concept of competitiveness and sustainability from the viewpoint of some highlighted economic theories.

endogenous factors (technology, knowledge and the internal resources of the region) can become efficient means of reducing regional disparities.

5. *New trade theory* states that the spatial variation of productivity derives from the varying levels of regional specialization, agglomeration and cluster formation. The spatial equilibrium shaped by centripetal and centrifugal forces is Pareto-efficient, therefore there exist no market automatisms that would induce spatial disparities.
6. In the *new institutional economics*, due to the constant change deriving from the dynamic interaction of the narrowly meant economic processes and institutional conditions, the deepening or the reduction of territorial disparities can be well interpreted within the frame of the model.
7. The Porterian *corporate strategy economics* originates the regional disparities from the basic industries and clusters of the regions. Since it focuses on the "microeconomic foundations" (the resource munificence of the region gains highlight as well), the reduction of territorial disparities characteristically does not occur through market automatisms.
8. In an *evolutionary economic* view the change in the intensity and extent of a region's innovative activities can significantly shape the regional disparities (Bajmócy 2008). Such changes may occur as a result of spontaneous market processes. Therefore in the evolutionary thinking the reduction of territorial inequalities through the market automatisms can be interpreted.

Numerous successful attempts have been carried out for the empirical verification of the Williamson-hypothesis (Kiss–Németh 2006, Davies–Hallett 2002, Szörfi 2006, Nemes Nagy 2005). Several authors managed to confirm on large samples and long-run time series that from the initial state of relative-underdevelopment regional disparities increase for a while, and when reaching a certain state of development the divergent process turns into a convergent one.

At this point we necessarily come to the question that is to say what is that certain "*state of development*" where the divergence turns into convergence? It is equally important to establish whether in the relatively underdeveloped regions *this point exists at all*, or in the divergent phase the development potential of these regions decreases to such an extent which makes their later close-up impossible.

This threat is much realistic, because the more developed areas have increased ability to become an integral part of the global economy, foreign direct investments also flow first into these regions (Enyedi 2000, EC 2004). This results in the real danger of the widening of the regional inequality gap. "*In Hungary territorial disparities significantly deepened in the early 1990s after the changing of the political system*" (Rechnitzer 2000, p. 13.). This process has not deceased by the early 2000s.

3. Single-variable analysis of the evolution of territorial disparities

One of the most widely used (one might say conventional) method for examining the evolution of territorial disparities is the analysis of the *temporal and spatial change of per capita GDP* (Sala-i-Martin 1996). According to the method we gain a picture about the evolution of territorial disparities by analyzing the dynamics of standard deviation values computed from the natural logarithm of per capita GDP data measured in PPS[3], compared to the Hungarian counties' and regions' averages. If the computed standard deviation values rise year by year, it indicates that the values deviate from their average in a growing extent, therefore the disparities of the observation units' per capita GDP data (measured in PPS) rise year by year.

Considering the Hungarian NUTS-2 level regions, NUTS-3 level counties and LAU-1 subregions as observation units, the growth of territorial disparities can be detected according to the results of a standard deviation analysis of the per capita GDP, measured in PPS on time series from 1996 to 2006. During the analysed time period the curves of both counties' and regions' standard deviation values are positive gradient, thus the observation units' state of development measured in GDP are shifting away from each other, in other words they *show divergence* (Figure 2).

The execution of the standard deviation analysis for LAU-1 sub-regions brings us to similar consequences. We must add however one extremely important notice: instead of the indicator used in case of counties and regions (GDP), we have to apply a similar-in-content indicator, the gross value added[4] (GVA), because GDP data are not available for aggregation-levels lower than counties (NUTS-3). Similarly to the standard deviation of counties' and regions' GDP, the standard deviation of sub-regions' GVA data can be characterized by a positive gradient curve in the 1996-2005 interval. This underlies the *growth of territorial disparities in the sub-region level as well*.

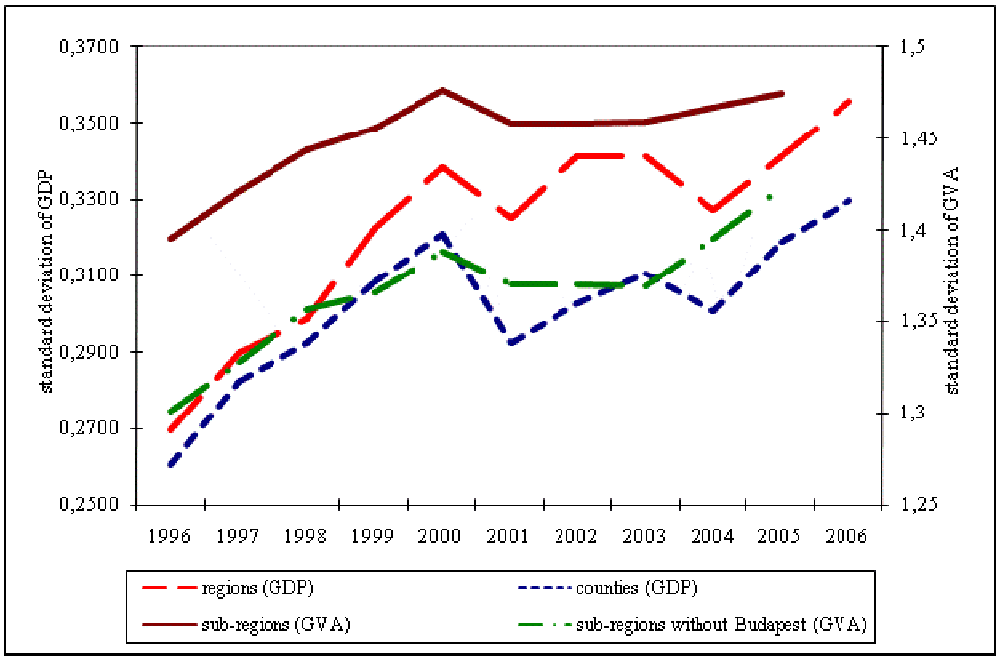
This statement is true both when the population includes all the 168 sub-regions[5], and when the analysis is carried out without the Budapest sub-region. We certainly receive significantly higher standard deviation values for the population that includes Budapest compared to the case when we carry out the analysis without the sub-region of the capital. This also underpins the well-known fact that Budapest and its agglomeration, which excel in the Hungarian spatial system and grow faster than the country average, *significantly contribute to the widening of Hungarian territorial disparities*.

[3] The guiding methodology of GDP computations is ESA 1995. The per capita GDP expressed in PPS (Purchasing Power Standard) is the value computed on the basis of purchasing power parities, expressed in Euro (Eurostat 2004).

[4] The gross value added produced by the economic units adding taxes on products and subsidies, subtracting the charge of financial intermediation results the value of gross value added computed on market prices, the indicator of gross domestic product (GDP).

[5] At the time of this paper's submission the data are not yet available for the 174 new sub-regions defined by Act CVII of 2007.

Figure 2. Change in the regional disparities of the Hungarian regions, counties, sub-regions

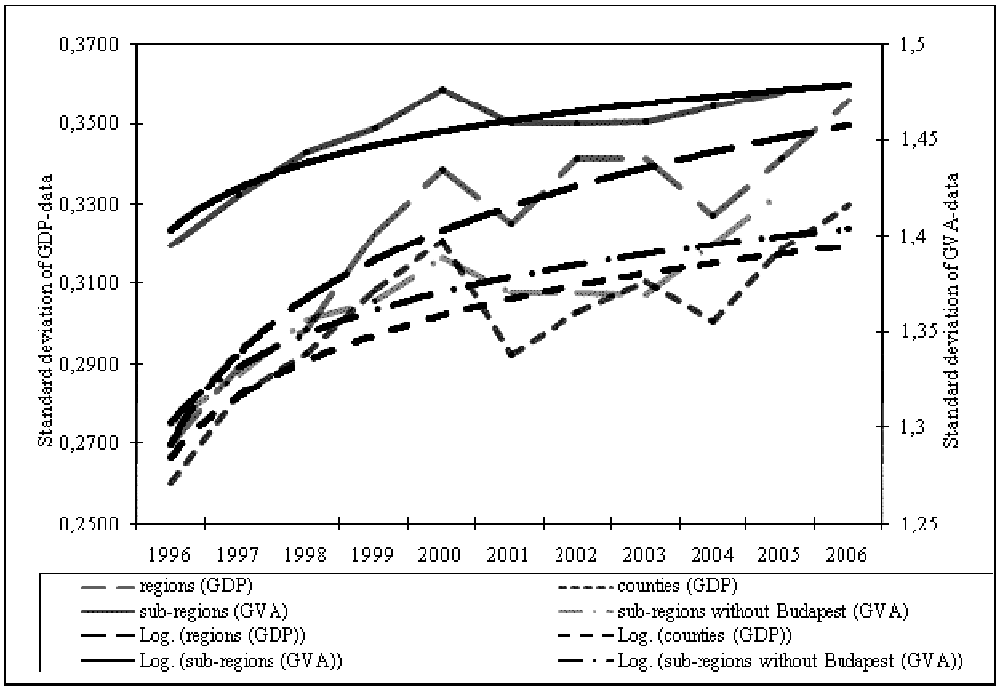


Note: calculated with natural logarithm
Source: own calculations on the basis of HCSO (2009)

The standard deviation values computed both from regional and county GDP, and sub-regional GVA provide the possibility of calculating trend-curves, in other word to demonstrate regularities in the evolution of data points. On the basis of R square as a control indicator it can be declared that the *logarithmic trend* fits well in all the four cases on the empirical data. It delineates in all the four cases the *left side of an U-shape curve* (Figure 3). By comparing these results and the Williamson-curve on the basis of the per capita GDP data we can state, that Hungarian territorial processes are in the divergent phase yet, in all the examined levels of aggregation[6].

[6] A convenient situation would be resulted if the statistical toolbar, by using trend-extrapolation, was able to define the point where the Hungarian territorial processes turn from the divergent to the convergent phase in the certain levels of aggregation. However trend forecast would be misleading in this case, since the logarithmic trend curve fitted on the past empirical data approximates to a zero-gradient linear curve when fitted on future points (where $t \to \infty$).

Figure 3. Logarithmic trend of the change of the Hungarian regional disparities



Note: calculated with natural logarithm
Source: own calculations on the basis of HCSO (2009)

In the foregoing the *examinations of territorial disparities were restricted to the analysis of a single indicator, the GDP per capita (or in sub-regional level the GVA)*. We are convinced that spatial processes are *much more complex* than they could be described by one highlighted indicator. The trend in the literature of spatial analyses apparently shows that *it is insufficient to use single-variable approaches to measure the territorial process*. Instead, the application of complex indicator-systems is required to reach sophisticated conclusions (Lengyel–Lukovics 2006, Lukovics 2007, Lukovics 2008).

4. Methodological background of territorial disparities' multivariable analysis

In the following we demonstrate an approach for analysing territorial disparities that is much more complex than the pure examination of per capita GDP data. The method applies a complex indicator-system which is based on the concept of competitiveness. In order to assure the greatest possible accuracy of the analysis, the criterion of choosing an indicator into the basic indicator-system of the analysis can

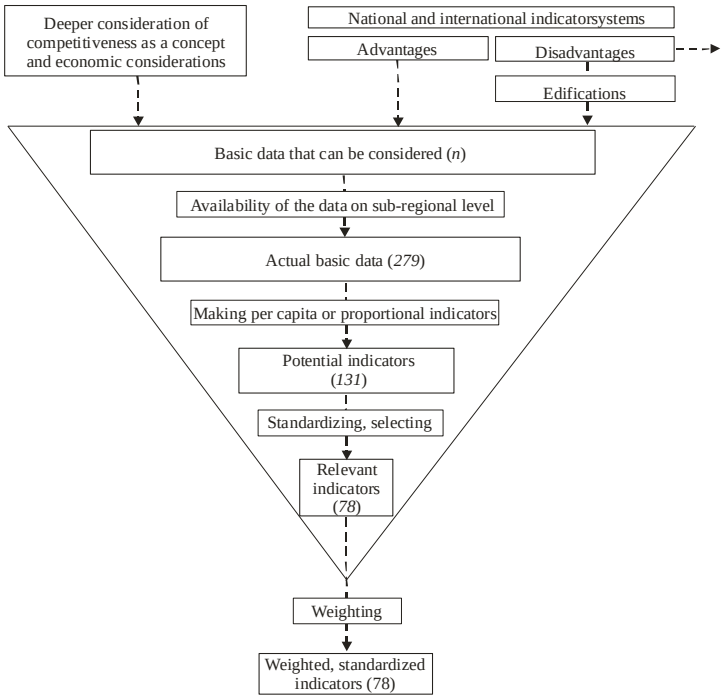
not be based on the subjective considerations of the analyst. It is required to endeavour to minimize the analysts' subjectivity.

Miklós Lukovics and Péter Kovács (2008) developed a methodology for implementing regional competitiveness analyses, which is based on a closed logical system and where the mathematical-statistical background ensures the minimizing of analyst's subjectivity. The closed logical system of the applied method is assured by the fact that indicator selection is coordinated by a model unfolding the standard definition of competitiveness, the pyramid-model.

The data set serving as the foundation of the analysis is designed on the basis of the standard definition of competitiveness, and the pyramid model unfolding it. It is important, that the final database – that serves as the basis of multivariable data analysis methods – *emerges as a result of a multiple-stage* process (Kovács–Lukovics 2006). The first step defines the *basic data* that can be considered in the case of surveying competitiveness on the sub-regional level. These data can be defined on the basis of a deeper consideration of competitiveness as a concept and economic considerations, taking into account the most important experience of the reviewed international and national analyses. The fact that certain data are absolutely unavailable on the sub-regional level limits the inclusion of a great number of data as actual basic data; therefore, *actual basic data* are made up of the basic data available on the sub-regional level. These basic data may be considered as raw data, from which *potential indicators* can be produced with the help of simple mathematical operations. Selecting potential indicators with the help of principal component analysis leads to the *actual, relevant indicators* that finally serve as the basis of the analysis. The database reaches its final form after the *standardizing* and *weighting* of the relevant indicators (Figure 4).

Similarly to the variable-selection method we used *principal component analysis* to make an *objective weighting system*. The determination of the weights is based on the following train of thought. If we substitute the standardized variables with principal components, the principal components represent the model in reduced dimensions. As an output of the principal component analysis we receive the values of the communalities. Since the communalities are practically coefficients of multiple determinations in a linear regression model, where the dependent variable is the given variable, and the independents are the principal components, the square roots of those are coefficients of multiple correlations. In general the coefficient of multiple correlation quantify the correlation between the effective (empirical) and the estimated values of the dependent variable. Thus it also quantifies the correlation between the dependent variable and the set of independent variables. *Especially the coefficient of the multiple correlation means the correlation between the given standardized variable and the set of principal components, which represent the pyramid model. Thus, the coefficients represent the correlation between the variables and the model, namely the weight of the variables.*

Figure 4. Creating the database of the analysis



Source: Lukovics (2008, p. 116.)

After successfully accomplishing selection and weighting we receive a database in a structure that is in line with the pyramid model unfolding the standard definition of competitiveness, and that consists of 78 selected (therefore relevant regarding competitiveness), standardized, and weighted variables. As an empirical application of the developed method, we carried out the complex grouping of the 168 Hungarian sub-region on the basis of their competitiveness. This also provided an opportunity for the multi-variable analysis of territorial disparities.

5. Multi-variable analysis of territorial disparities

The model is expected to ensure *comparability in time*, which means that *beyond the relative competitiveness of the different sub-regions, its changes and through this the change of the regional disparities can also be examined* by introducing the latest statistical data to the database consisting of the selected system of indicators.

I intend to draw conclusions about the evolution of territorial disparities by examining the changes within the complex competitiveness classification of Hungarian sub-regions between two dates: 1998 and 2004. I use the well-known method of cluster-analysis, which, to the best of my knowledge, has not been used

for this purpose before. The closed logical method describable by the objective selection and weighting process of indicators based on the pyramid model of competitiveness also offers a chance *to complete an annual assessment of the changes in the relative competitive position of Hungarian local administrative units* and the changes of the regional disparities.

In our analysis, we compared the types of competitiveness of the different sub-regions in 1998 and in 2004. We studied which are the sub-regions whose competitiveness changed so much in the examined two years that their position assumed in clustering was also modified. Looking at the period between 1998 and 2004, only *ten sub-regions were found* whose ranking in clusters based on complex competitiveness changed by 2004 compared to its state in 1998.

Certain peculiarities must be emphasized though, which significantly influenced my endeavour:

1. Similarly to territorial GDP data, sub-regional GVA data are available also with a two-year delay. At the time of implementing the analysis – in the middle of 2007 – the most up to date territorial GVA data were from 2004. Therefore all the other data included to the database refer to 2004 as well.
2. The Government decree 244/2003 defined 168 sub-regions in Hungary[7] contrary to the earlier 150, which existed in 1998. This hindered the comparison of data in the level of sub-regions, but by aggregating the municipality-level data we managed to create data also for the previous years that are suitable for the new structure.
3. Since the database contains numerous specific indicators, it is very important that population data has significantly changed from 1998 to 1999. The reason for this is the recount of the previous estimated (forward counted) data.
4. The Hungarian Central Statistical Office's (HCSO) registration of enterprises by staff categories significantly changed between 1998 and 2000.
5. The calculation of unemployment rate has been in harmony with the ILO recommendation only since 1998. The HCSO previously provided the data of the Employment Offices (referring to registered unemployed).
6. Certain indicators (the number of ISDN main lines, simplified corporate taxes) are not available for 1998. In these cases I included data from the closest possible year to 1998.
7. Data of the 2004 model deriving from the 2001 population census are displaced by data from the 1990 population census in the 1998 model.

In order to draw conclusions with reference to the evolution of territorial disparities on the basis of change in the complex competitiveness classification of Hungarian sub-regions between 1998 and 2004, first we must carry out the

[7] The Act CVII of 2007, which defined 174 sub-regions, has not been passes at the time of the examination.

classification separately for the two years. I sorted the 168 Hungarian sub-regions for both 1998 and 2004 into three clusters by applying K-means cluster methodology based on 78 selected and weighted indicators in line with the Pyramid-model. For both 1998 and 2004 data less than 10 iterations were sufficient to develop a steady structure, hence the cluster affiliation of the territorial units based on their competitiveness is considered to be unambiguous.

Although the number of objects belonging to each clusters are the same for the two examined year, the distance of clusters from each-other and the membership of the cluster show difference to a certain extent.

If we analyse the evolution of the Euclidean distance of the cluster centres for the given years, we receive a new approach of the examination of territorial disparities (Table 1). Whether the distance of cluster centres rise from one point in time to the other, the relative competitiveness of the region-types move away from each-other. This is equivalent with the statement that territorial disparities increased between the examined points of time, and vice versa.

Table 1. Euclidean distance among the final cluster centers in 1998 and 2004

Cluster	**Relatively weak competitiveness**	**Medium competitiveness**	**Relatively strong competitiveness**
Relatively weak competitiveness		8,672 (8,511)	34,968 (40,772)
Medium competitiveness	8,672 (8,511)		28,997 (35,110)
Relatively high competitiveness	34,968 (40,772)	28,997 (35,110)	

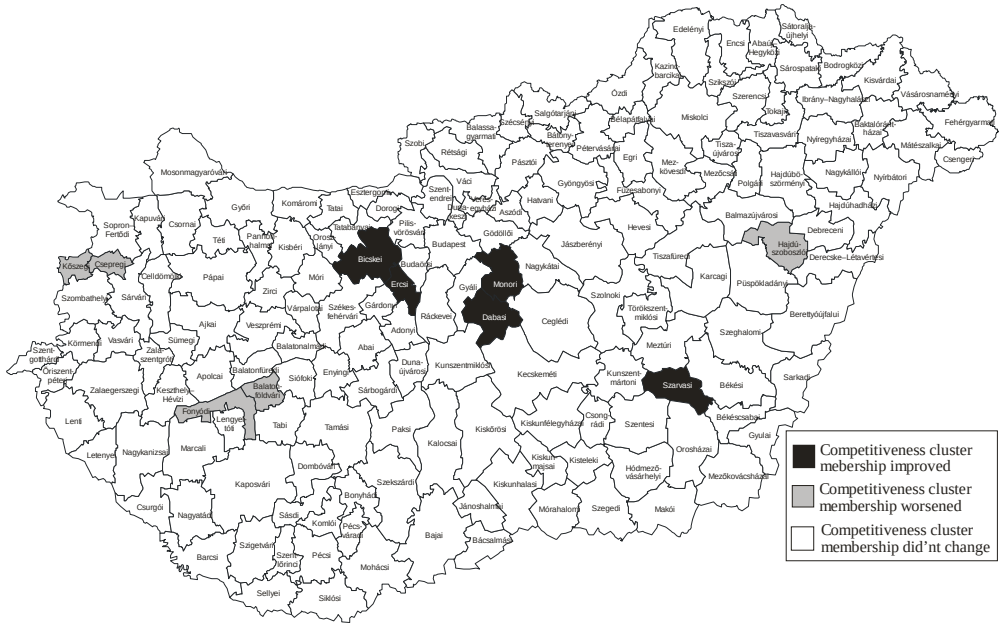
Note: Data of 2004 are in brackets
Source: own calculations

Based on the Euclidean distance of the final cluster centres, it must be underlined that *in 1998 the three clusters were situated closer to one another than in 2004*. Between 1998 and 2004, the distance of the cluster with relatively weak competitiveness and the one with medium competitiveness did not change significantly, however, the Euclidean distance between the clusters of the sub-regions with medium competitiveness and the one with relatively strong competitiveness grew significantly, and the same happened in the case of the clusters of sub-regions with relatively weak competitiveness and those of relatively strong competitiveness. *This observation, in a way, proves the increase of spatial disparities*. This recognition not only shows the growth of spatial inequalities, but also confirms the fact that the cluster of *Budapest* with relatively strong competitiveness *underwent much more dynamical development* in the examined period *than the sub-regions constituting the other two clusters.*

It can be stated about the spatial concentration of competitiveness and urbanization that there is no significant difference between the results based on the data compiled in 1998 and in 2004: the only sub-region with relatively strong competitiveness (the capital) is surrounded by the ring of sub-regions with medium

competitiveness, 90% of which are urban in both years. Furthermore, the urban sub-regions with medium competitiveness are on the one hand the sub-regions of the chief towns of counties and the sub-regions of large towns. Sub-regions with medium competitiveness (urban and rural alike) are concentrated in both years in the vicinity of developed Western centres and highways. Beyond this, it can also be stated that in 1998 and in 2004 a concentration of sub-regions with medium competitiveness can be found in the North-Western and Central regions of the country, while sub-regions with weak competitiveness are situated in the zones along the Northern and Eastern country borders. According to the data compiled in 1998 the dominance of the lake Balaton can be stated: significantly more sub-regions with medium competitiveness concentrated along the lake in 1998, than in 2004.

Figure 5. Change of the competitiveness cluster memberships of the sub-regions (1998-2004)



Source: own calculations

We also studied which are the sub-regions whose competitiveness changed so much in the examined two years that their position assumed in clustering was also modified. Looking at the period between 1998 and 2004, only *ten sub-regions were found* whose membership in clusters based on complex competitiveness changed by 2004 compared to its state in 1998. It should be underlined, that presumably the competitiveness of more than ten sub-regions changed in the examined period, but

the degree of change only resulted in cluster membership changing in case of 10 sub-regions (Figure 5).

From the ten sub-regions mentioned above, five (Bicskei, Dabasi, Ercsi, Monori, Szarvasi) improved its competitiveness cluster membership, five (Balatonföldvári, Csepregi, Fonyódi, Hajdúszoboszlói, Kőszegi) worsened it. The realignment of the competitiveness types is also remarkable: the competitiveness position of the wider Budapest-agglomeration improved.

6. Summary

In the present paper we attempted to introduce a method for analysing territorial disparities based on the concept of regional competitiveness, which analyses the spatial processes by using (within the model)an objectively selected and weighted system of indicators. The essence of the method – beyond the multi-step creation process of the database – is that it analyses the evolution of territorial disparities on the basis of the final output of a multi-variable data analysis (namely the Euclidean distance of cluster centres), contrary to the most commonly used standard deviation values of per capita GDP.

According to both single-variable standard deviation analysis and multivariable examination, regional divergence can be reported in Hungary on a sub-regional level. Sub-regions with relatively high competitiveness increase their competitiveness, while sub-regions with relatively weak competitiveness fall behind. Furthermore it can be stated that the competitiveness of sub-regions in "convergence" regions is much heterogeneous: the competitiveness "engines" of these areas are the sub-regions of county centres and towns with county authorities, while the competitiveness of other, mainly rural sub-regions is weak and degrading in tendency.

These results necessarily call for the continuation of recent research: does the competitiveness potential sub-regions with relatively weak competitiveness degrade to such an extent as a result of the growth in territorial disparities that is may hinder the future catching-up.

It is necessary to survey in these sub-regions the factors that may contribute to the development of their competitiveness. For this purpose those elements of recent selected and weighted set of indicators that map the "development factors" and "success determinants" of the Pyramid-model provide a possibility. As a result of a competitiveness analysis based on the above indicators (that represent the possible directions of development strategies), it can be found out, whether sub-regions with relatively weak competitiveness possess merely a weak ex-post competitiveness, or also a faint catching-up potential.

If the results showed that also the opportunities for improving competitiveness are scarce in the sub-regions of relatively weak competitiveness, there would be a

real danger of the economic degradation of these areas. In this case the realistic aim for these sub-regions is not the catching-up, but the ceasing of further falling-behind.

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"Analyse this" – Cluster-mapping in Szeged and Csongrád County

Réka Patik

As cluster-mapping – identifying potential and existing clusters in a region's economy – has found its place in foreign literature, several attempts have been made in Hungary to reveal the economic structure of the country, a specific region or county, and to find their high-points. Despite the fact that an effective regional or local development process with the rational use of the resources at hand ideally needs the outputs of a thorough study revealing the true drivers of the economy, in practice the toolkit of cluster-mapping is often ignored. The reason is the difficult and problematic adaptation of the tools introduced in the foreign literature: statistical databases have their shortcomings, primer data collection is rather costly.

An inquiry into Szeged and its subregion and Csongrád County has been done on the basis of this toolkit, however. Besides the awareness of deficiencies and difficulties, this study gives results based on exact data. These results may also form the starting point of further studies. The economic structure of the region is analysed from different aspects, which together lead to certain consequences and also to the identification of the potential "Human resource", Construction and various processing industry clusters of the region. The study shows some possible ways for the university to enter the regional development scene.[*]

Keywords: cluster-mapping, cluster policy, peripheral regions, regional concentration

1. Introduction

Several countries' and regions' economies answer global challenges with the spatial concentration of economic activity. It has been proved that spatial proximity provides such advantages (positive local externalities) to the regional economic actors, which enhance their competitiveness and chance for success in international competition (Lengyel–Deák 2002).

In recent years, the Hungarian economic literature has turned towards clusters and cluster-based economic development (Buzás 2000, Deák 2002, Gecse–Nikodémus 2003, Lengyel 2001, Lengyel–Deák 2002, Lengyel–Rechnitzer 2002). This study deals with only one segment of building and implementing a cluster-policy aiming at developing clusters and therefore competitiveness. This segment is

[*] Many thanks to Alice Chapman-Hatchett (International Partnerships Officer, International Affairs Group – Strategy Division, Kent County Council, UK) for the language review of this study.

cluster-mapping. The focus of the study introduces the methodology from a practical point of view: adaptability of the mapping toolkit[1] in Hungary, experience drawn from the statistical data based empirical study of Szeged and Csongrád County.

2. Focus and methodology

Demonstrating the commitment of international organizations towards clusters, a series of cluster-studies has targeted the region. The 2002 studies of the LEED program, however, stated that Hungary had no real clusters (Ionescu–Möhring 2002). In 2005 a more sophisticated view was formed (OECD 2005): between 2002 and 2005 clusters emerged in several industries (automotive, logistics, construction and tourism).

2.1. The region in focus

Csongrád County is part of the South-Great-Plain Region at the South-Eastern border of the EU. This region has the third biggest population amongst the Hungarian regions (after the Central Region and the North-Great-Plain Region), according to its territory it is ranked fourth[2]. The county fits well the row of the neofordist, peripheral counties in the South-Eastern crescent of Hungary (Lengyel 2003). Despite or besides the opinion cited in the previous paragraph, in 2000 several cluster(-like) initiatives existed in the region (Buzás 2000):

1. „DÉL-THERM" Union including three heat- and thermic technology firms;
2. a textile-industry reintegration program with the participation of science institutions, led by HUNGARN Fonó Ltd.;
3. the textile industry subcontractors' coordination centre at Eurotex Ltd.;
4. co-operations in IT, the agrarian sector („onion-association", organic farming) and biotechnology.

The 2-digit SIC-code (division-level) analysis of employment data of the Hungarian regions and counties (Gecse–Nikodémus 2003) shows an over-represented presence of food-processing and textile industries here. The food-

[1] For a general review of the toolkit please see Patik (2005), for the detailed methodological description of the present study please see Patik–Deák (2005).

[2] Based on www.nepszamlalas.hu/hun/egyeb/hnk2005/tablak/load1_2.html. Download: 27th February 2006 (Population data refer to 1st January 2004, territorial data to 1st January 2005.)
The South-Great-Plain Region itself (18.338 km^2) is a bit bigger than the Walloon Region of Belgium, and a bit smaller, than Niederösterreich in Austria. As for the population (appr. 1.3 million inhabitants), it almost equals the Champagne-Ardenne region in France, or Estonia as a whole. Csongrád county with its territory of 4.262 km^2 could be compared to Luxembourg or the Danish Viborg county, its population of approximately 425 thousand people suggests the Belgian Leuven or the Italian Parma regions. The county has around 73 thousand employees and registers 34 thousand enterprises.

processing concentration is probably due to the canning factory of Szeged, the grain mill industry, meat processing (in Szeged, Csongrád and Szentes) and winemaking (in Csongrád, Mórahalom). Textile-industry is present in almost every bigger town (Hódmezővásárhely, Szeged).

Significant employment concentrations of Csongrád County have been revealed in the chemical industry (plastics, pesticides, paints, varnishes and rubber products) and china-production (Hódmezővásárhely).

Spatial concentrations do exist in Hungary; clusters are being formed with the adaptation of foreign best practice. The private sector has built several clusters, which are promoted and supported by the government. The South-Great-Plain clusters with governmental subsidy (these might be present in the region in focus) (Gecse–Nikodémus 2003):

1. Textile Cluster;
2. Public Works and Road Construction Cluster;
3. Tourism Cluster;
4. Handicraft Cluster.

The present study is unique in a way, as it uses 4-digit SIC-code (class-level) analysis on subregional and county level, working with a complex system of indices and criteria. More detailed and accurate results are awaited accordingly.

2.2. Methodology

All empirical studies should start with an operative definition of the phenomena to be measured. The literature documents dozens of cluster-definitions, based on different theoretical background etc. (Gordon–McCann 2000, Martin–Sunley 2003). Two basic approaches are agreed to set the theoretical background: economics and business studies (Phelps 2004).

Taking these two cornerstones into consideration, this study is guided by the second one. But choosing cluster-definition does not solely define the theoretical background and the terminology to be used: it is the definition which selects the applicable tools from the cluster-mapping methodology. A definition, which serves well the aims of the mapping process, is decisive for the measures describing the concentration of economic activity (i.e. employment, turnover, number of enterprises) and also for the spatial approach, whether geographical, social, economic, cultural etc. These are the critical milestones of the mapping procedure (DeBresson–Hu 1999). Accordingly, the alternative way of cluster-development is chosen in this study (Bergman–Feser 1999).

3. Defining the methodological framework

Before getting deeper into the facilities provided by the toolkit of cluster-mapping, several decisions have to be made, as seen above (Bergman–Feser 1999). Taking the cited train of thought into consideration, the following pages deal with the aim of the research, the cluster-definition used, the indices and methods used, and finally the consequences drawn.

3.1. Aims and cluster-definitions

As a first step, we have to investigate the region to be developed, we have to set an aim for development, which is delivered by the programs and strategies of the region finalised in the late 90s (MTA RKK ATI 1998, DARFT 1999). These documents unitedly stress that there is a need to adjust higher education to the economic structure. As a combination of the objectives of the region and the university the baseline of the current research is the following: *to launch the knowledge-based economy of Szeged and Csongrád County, to enhance the innovativeness of the region, with the active participation of the University of Szeged.*

Quite agreeably, the university can have an influence on the economy of Szeged and its region with the knowledge produced and used inside its walls, with its research capacity and infrastructure, with the new technologies created by or with the help of the university. Enright's definition (1998) describes these initiatives the best, however, the definition of Lengyel and Deák (2002) is also remarkable for the stress on the role of the drivers of local economy. Let our cluster-definition be the following according to these: *a local/regional driver of the economy, where the enterprises operate with shared infrastructure, labour pool and knowledge-base, using division of labour.*

This definition ensures geographical proximity along with features, which implicitly assume the existence of co-operating and supporting institutions (university, technology-transfer organisations etc.). As a consequence we can expect that it will guide the mapping activity and will help in choosing the adequate tools from the methodology.

3.2. Methodology options

Before going deeper into the introduction of the toolkit, it is important to emphasize that we are going to deal with the mapping of potential clusters – no matter which index or method we use. A real cluster can be identified as a result of a multi-step analytical process. Using the chosen method on the data at hand potential clusters are identified which need to undergo further analysis. Using one single method will not result in a reliable output. Based on this we are going to see how the keywords of the definition can be investigated with the different methods.

Finding the drivers of the economy leads us to the problem of measuring the concentration of economic activity. An economic activity presumeably drives the regional economy, if it has a dominant role in the economy and shows considerable growth. It should also be a traded industry. The first two aspects can be derived from added value, the share of employment and the number of enterprises. The share of export can feature the traded characteristics[3].

As mentioned before, the definition implicitly contains spatial proximity, geographic concentration. During the research this feature is assisted by the source of the data-set: all data refer to Szeged, the Szeged subregion and Csongrád County. In the following pages the keywords of the cluster-definition are "translated" into indices and analytical methods (a-g), thus forming the methodological frame of the mapping.

a) Share of added value, growth of added value. Added value is hard to investigate along 4-digit SIC-codes or on subregional level. The data-collection of the Hungarian Central Statistical Office (HCSO) represents the county level and the 2-digit SIC-code depth. No more detailed data are available, that is why the drive of the economy cannot be analysed well enough through added value[4].

b) Employment data. Employment data are expected to reveal the economic structure of the county and subregion through the employment share of the different economic activities, showing the size of the common labour-pool. The most often used index in this case is the location quotient, the LQ-index, exhibiting economic specialization. The LQ-index based on employment data is referred to as "employment-LQ" in the future, to distinguish it from other LQ-indices.

Despite the constraints of the usage of the employment-LQ (see Brenner 2004 for more details), this index was the central tool of the British cluster-mapping project (Miller et al. 2001). In Hungary a similar methodology assisted Gecse and Nikodémus (2003). These two projects had quite different value limits when setting the evaluation criteria, when deciding an economic activity's being a high-point or part of a cluster. Differences exist moreover in the depth of the dataset, the territorial level in focus – both studies serve as a guideline for this mapping, though.

Beside employment-LQ another important index is the change of employment. This latter has its own problems, too: it is easily influenced by the number of enterprises, productivity, capital adequacy, technological level of the economic activity investigated. However, the growing number of employees might mean the growth of the critical mass.

c) Number of enterprises, change in the number of enterprises. An attractive option for the comparison of the number of enterprises in different regions might be

[3] Certain economic activities are able to attract income into the region, although their output is not tradeable, so it won't add to the export data: tourism, higher education, R&D. These activities ought to be investigated more thoroughly.

[4] Based on consultations with the experts of the Hungarian Central Statistical Office, Summer and Autumn 2004.

the use of the general LQ-index filled with enterprise data – the "enterprise-LQ". An enterprise-LQ above 1 shows relatively more enterprises in an industry than the national average. However, the number of enterprises in different regions may vary according to the regions' economic structure. The enterprise-LQ – the relative number of enterprises as a mapping tool – could be misleading: caution is required. It is important to conclude that the enterprise-LQ will definitely not show the specialization of the region, but it gives a good hint on the size-structure of the economic organisations (more precisely: of the average relative size of the economic organisations). That is why it is going to be used as a secondary index, to elaborate the view of the economy given by other, "more reliable" tools.

More information on an economic activity is given by the number of enterprises, and the change in the number of enterprises. Here also it is not so much the size of the industry, but the structure, which counts. In Hungary these indices can be perfectly used, data are fully available from the HCSO.

d) Export. The RCA-index (revealed comparative advantages; used mainly in world economy) can be considered as an LQ-index, too. It has the same structure, filled with the appropriate export-data, and it shows the specialization of a region illustrated by the export activity. The "export-LQ" is not often used on a regional level, but as the output-side reflection of the employment-LQ it was worth introducing it.

Its usage in Hungary is difficult; a rather limited series of data is available on the 4-digit SIC-code level. As a consequence, the export-LQ is only used as a complementary tool.

e) Qualitative case-studies. Qualitative case-studies might reveal several of the keywords in our cluster-definition: shared infrastructure, knowledge-base, division of labour (appearing as transactions among regional actors, input-output relationships). They make hardly measurable characteristics less elusive.

As several foreign case-studies are available today, there is an opportunity for benchmarking, one might collect the distinguishing features of an industry's clusters. It is also possible to recognize those infrastructural and institutional ingredients which make the clusters function and flourish, or the presence of which might indicate the existence of a similar cluster in Hungary. Porter's diamond is often used when this method is chosen (Roelandt–den Hertog 1999, Lengyel 2000).

f) Number of patents. The birth of shared technology could be traced via the number of patents. Together with the patent citations in the USA this indicator is appropriate for following the spreading of technologies and for finding the shared technology base (Jaffe et al 1993). Hungarian adaptation is influenced and hindered by the discrepancy of the Hungarian patenting system as compared to the American. The patents of the Csongrád County organisations might reveal the innovative activities of the region, though.

g) Transactions and relationships among the regional actors. Analysing division of labour and the value chains equals the mapping of both spatial and

economic proximity, provided that the data investigated refer to the appropriate territorial level. This comfortably leads us to meeting the expectations recorded in the cluster-definition. Two elements of the mapping tool-kit are widely used here: input-output analysis and graph-analysis, but qualitative case-studies have the potential of revealing transactions and relationships, too. All three are part of the OECD-recommended methodological range (Roelandt–den Hertog 1999).
The input-output analysis is well known in Hungary (Lengyel–Rechnitzer 2004). Unfortunately, for the region in our focus no input-output matrix is available, and creating our own matrix would require additional resources.

Graph analysis (usually based on input-output matrices) would give a nice illustration of the region's economy (see i.e. Luukkainen 2001, p. 284.). The difficulties of its usage lie in the matrix itself, as explained earlier. That is why these methods are not easy to use in Hungary.

4. Adapting the methods in Hungary – data and methodological setbacks

The previous paragraphs have proved that the potential clusters of Szeged and Csongrád County can be analysed mainly from two sides: employment and the number of enterprises. These are completed by the export data to sophisticate the results. The identified potential clusters could be tested by qualitative case-studies in the future.

After the overview of the Hungarian statistical databases with regard to the territorial level and "depth" (number of SIC-code digits) of the data, the following indices can be used to map Szeged and Csongrád County on merits:

1. employment-LQ,
2. share of regional employment,
3. enterprise-LQ,
4. number of enterprises and its change,
5. export-LQ.

4.1. Data imperfection

The different employment patterns of certain industries and economic activities (i.e. outsourcing) might distort the value of the employment-LQ. Thus the real size of an industry is certainly bigger than shown by the data. A similar problem is – as pointed out by Gecse and Nikodémus (2003) – that the HCSO does not collect employment data from the organisations with less than 4 people. The number of employees in organisations with 4-49 people is estimated, as a result there is a possibility of imperfection.

The use of the export-LQ is made more difficult by the fact that the HCSO collects export data exclusively from the processing industry firms with more than

50 people. Moreover the act on data protection prohibits the declaration of data in economic activities with 3 or less actors. It narrows our data set[5].

When interpreting the export-LQ it should be noted that the HCSO takes export as transporting goods outside the border of Hungary. As a result, export data are incapable of showing trade among the regions or counties, and traded industries.

Further data imperfection derives from the deficiency of the industrial classification system: not every economic activity is replaceable with one or more SIC-codes, mainly the activities of the "new economy", creative industries etc[6].

Some data are collected according to the location, others according to the premise of an enterprise; some refer to Szeged, others to the Szeged subregion.

4.2. Methodological shortcomings

Methodological shortcomings derive mainly from aggregation, the decision on the value limits and the choice of the benchmark or the point of reference.

Aggregation influences mostly the LQ-indices and the share of the economic activities. The minimum size of the different activities on different territorial levels must be defined carefully. This is also true for the different levels of industrial classification aggregations.

Choosing the value limit means giving the value of an LQ-index, from which the given economic activity is considered relevant or concentrated. Theoretically, this limit is 1[7], but in practise caution is required (Brenner 2004). The limit for the employment-LQ should be above 1.

The differences in the employment patterns are not to be ignored in the empirical analysis, though, mainly when analysing parts of Hungary. The employment ratio of the Hungarian regions varies greatly, which distorts the employment-LQ, when having the whole of the economy as a benchmark. In a more developed region non-traded community-services are over-estimated, traded activities are under-estimated. In the peripheral regions the effect is quite the opposite. This effect can be eliminated if the traded industries serve as a benchmark.

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[5] Although the mere existence of publishable data in itself shows the significance of an economic activity – it means that there are at least three regional actors with traded products and export activity and with more than 50 people each.

[6] The literature often doubts the ability of the NACE (SIC-code based analysis) to answer the questions about a regions economic structure. A basic problem is that the classification systems seemingly do not follow the evolution of the economy: the activities of the new economy, creative industries and biotechnology are not classified. It is true for the NACE Rev.1.1. of the EU, ISIC REV.1.1 of the UN and the harmonised Hungarian TEÁOR'03, too (KSH 2002).
North-America (Mexico, the USA and Canada) has remedied these problems recently. NAICS (North American Industrial Classification System) has been created, renewing the traditional classification and enhancing the depth of the data (6-digit codes) (Tűű 2003).

[7] At Gecse–Nikodémus (2003) the regional and county-level value limit for the employment-LQ is 1, at Miller at al (2001) the regional limit is 1,25, the local is 5.

To sum up, in the analysis of the data it is worth having LQ-index limits above 1, and having traded industries as benchmark. But selecting traded industries is not an easy task. The literature documents several methods to do that (Stimson–Stough–Roberts 2002, Porter 2003), these cannot be used in Csongrád County or Szeged.

5. Mapping Szeged and Csongrád County

Cluster-mapping in practise puts several problems and setbacks into the limelight. The analysis of Szeged and Csongrád County illustrates most of them impressively – that's why this mapping project might serve as a guideline for other Hungarian mapping approaches.

To return to the train of thought cited and used earlier, the tools and indices are defined now, this should be followed by setting the system of criteria, value limits, the sequence of the tools and indices.

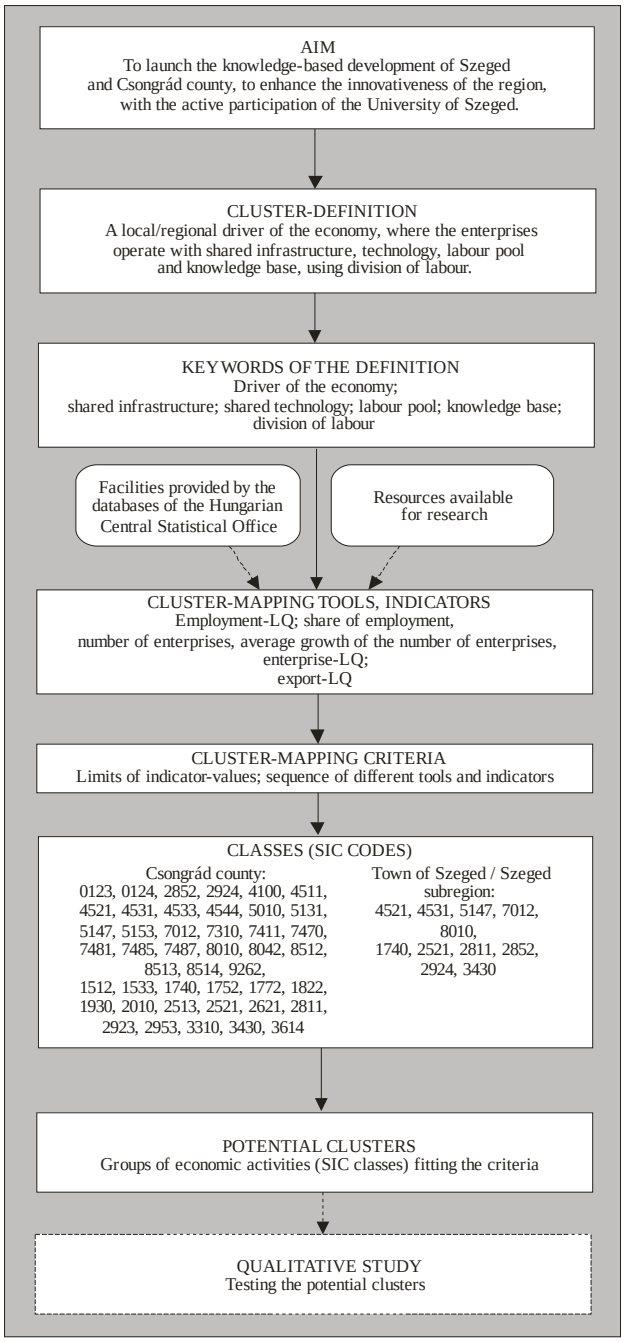
After these decisions are made, the investigation runs this way: the first step is the employment-LQ and the share of regional employment, using the economy as a whole as a benchmark (owing to the problems of dividing traded and non-traded industries). The deficiencies deriving from this benchmark are expected to be set off by the combination of several indices and tools. The mapping runs parallel for Szeged and Csongrád County.

Both employment-LQ and the share of employment are calculated with 4-digit SIC-code data for the year 2003 for Szeged and Csongrád County. In case both meet the expected value limits, the second step is analysing the number of enterprises. The data regarding the number of enterprises are for the year 2004, and these are also 4-digit SIC-code "deep". Those classes/activities which do not match the employment criteria, are removed from the research. Those having deficiency with respect to only one employment indicator are to be analysed further if they show enough enterprises. In this case two of three data prove the critical mass.

Classes with few enterprises but with good employment indicators might "suffer" from the unique features of the economic activity itself. In this case the enterprise-LQ can answer the question, whether the low number of enterprises is a general national phenomena or a regional characteristic.

Another specification for clusters was expected growth. A potential driver of the regional economy should show growing number of actors – indicated by the annual average growth of the number of enterprises regarding the 1999-2004 period.

Figure 1. The process of the cluster-mapping



Source: own construction

The limits of the indicator-values as a set of criteria have been defined according to the foreign and Hungarian mapping practise. More combinations of value limits were tested to result in an acceptable number of activities, regional "high-points". It was also expected that the set of economic activities resulted from this research should include industries with export-capacity.

The set of industries left at the end of the process should be further analysed by qualitative case-studies, so as to group them into potential clusters, to reveal connections, co-operations among them etc.

After testing different sets of limits of indicator-value, Csongrád County showed 27, Szeged (and its subregion) showed 5 SIC classes which correspond to the criteria. (More than in the case the British or the Hungarian Gecse–Nikodémus values were used.) These classes are to be supplemented by the activities with export data as a second row. Grouping into clusters has been done with the analysis of the content of the SIC-codes, lacking a qualitative case-study (Figure 1).

6. Results

Results and experiences appear in two fields: the usage of the methodology and the development of Szeged and Csongrád County.

Methodologically the most conspicious difficulty was the quality of the data, which slowed down the whole mapping process. The Hungarian system of SIC codes was altered in 2002, and the modification was not consequently applied to the data (comparing those from 1999 with the more recent ones for example). Another disadvantageous factor was the lack of data. In some cases no employment data were published in spite of the fact that the number of enterprises was much higher than the limit for data-protection (it is three as mentioned earlier). Altogether 192 activities were analysable on the county level, 55 on the town or subregional level – all of the different data were available only in these cases from among the 518 4-digit SIC-code activities. Of course using the indices separately was possible for more than 55 or 192 activities.

We have now come to the point where the activities fitting the system of criteria are to be investigated further (Table 1 and 2). *On the whole in Szeged and the Szeged subregion five potential clusters are identified: the Construction Cluster, The Human Resource Cluster* (including activities contributing to the development and "maintenance" of the human resource of the region), *the Metal and Machinery Cluster, the Textile and Footwear Cluster, and the Plastic Cluster.*

Table 1. Potential clusters of Szeged

Name of potential cluster	Economic activities chosen through the mapping process	Percentage of employment in Szeged	Percentage of enterprises in Szeged
Construction	4521 General construction of buildings and civil engineering works 4531 Installation of electrical wiring and fittings 7012 Buying and selling of own real estate	3,99	4,68
Human resource	8010 Primary education	3,82	0,30
Metal and machinery	2811 Manufacture of metal structures and parts of structures 2852 General mechanical engineering 2924 Manufacture of other general purpose machinery n.e.c. 3430 Manufacture of parts and accessories for motor vehicles and their engines	1,31	1,24
Textile and footwear	1740 Manufacture of made-up textile articles, except apparel	0,00	0,02
Plastic	2521 Manufacture of plastic plates, sheets, tubes and profiles	0,00	0,03
	5147 Wholesale of other household goods	0,40	0,32

Source: own construction

Meanwhile the county has a more wide-ranging processing industry character. The activities named at Szeged are present with much more 4-digit SIC-code classes. On the county level the clusters of Szeged are to be completed with the Meat Cluster, the Business Services Cluster, and the Fruits and Vegetables Cluster[8]. (There are some SIC classes, which couldn't have been grouped into any of the clusters, although they met all the criteria.) These clusters are obviously only hypothetical, regarding the cluster-definition at the beginning of this study. As long as an appropriate qualitative case-study confirms their existence, the living co-operations, division of labour and transactions inside a cluster, it is a mere assumption.

Critical mass (in employment and number of enterprises) is performed on county level by the Construction and the Human Resource Cluster. A critical mass in employment is perceived in Metal and Machinery, Meat, Textile and Footwear (Table 2).

[8] The region has unique features, too. For example the employment-LQ of the manufacture of cordage, rope, twine and netting is extremely high, but the number of enterprises is very low, just like the number of employees. The foreign cases take this activity as part of the textile cluster – following this practise it becomes a strong point of the region's economy, making it special among the others.

Table 2. Potential clusters of Csongrád County

Name of potential cluster	Economic activities chosen through the mapping process	Percentage of employment in the county	Percentage of enterprises in the county
Human resource	7310 Research and experimental development on natural sciences and engineering 8010 Primary education 8042 Adult and other education n.e.c. 8512 Medical practice activities 8513 Dental practice activities 8514 Other human health activities 9262 Other sporting activities	12,69	6,48
Construction	2010 Sawmilling and planing of wood; impregnation of wood 3614 Manufacture of other furniture 4511 Demolition and wrecking of buildings; earth moving 4521 General construction of buildings and civil engineering works 4531 Installation of electrical wiring and fittings 4533 Plumbing 4544 Painting and glazing 5153 Wholesale of wood, construction materials and sanitary equipment 7012 Buying and selling of own real estate	7,71	7,73
Textile and footwear	1740 Manufacture of made-up textile articles, except apparel 1752 Manufacture of cordage, rope, twine and netting 1772 Manufacture of knitted and crocheted pullovers, cardigans and similar articles 1822 Manufacture of other outwear 1930 Manufacture of footwear	5,27	0,62
Meat	0123 Farming of swine 0124 Farming of poultry 1512 Production and preserving of poultrymeat	4,36	0,54
Metal and machinery	2811 Manufacture of metal structures and parts of structures 2852 General mechanical engineering 2923 Manufacture of non-domestic cooling and ventilation equipment 2924 Manufacture of other general purpose machinery n.e.c. 2953 Manufacture of machinery for food, beverage and tobacco processing 3430 Manufacture of parts and accessories for motor vehicles and their engines 5010 Sale of motor vehicles	4,27	2,19

Business services	7411 Legal activities 7470 Industrial cleaning 7485 Secretarial and translation activities 7487 Other business activities n.e.c.	2,41	6,34
Plastic	2513 Manufacture of other rubbed products 2521 Manufacture of plastic plates, sheets, tubes and profiles	1,30	0,06
Fruits and vegetables	1533 Processing and preserving of fruit and vegetables n.e.c. 5131 Wholesale of fruit and vegetables	0,73	0,61
	4100 Collection, purification and distribution of water	1,11	0,06
	2621 Manufacture of ceramic household and ornamental articles	0,92	0,05
	5147 Wholesale of other household goods	0,44	0,26
	3310 Manufacture of medical and surgical equipment and orthopaedic appliances	0,31	0,30
	7481 Photographic activities	0,04	0,21

Source: own construction

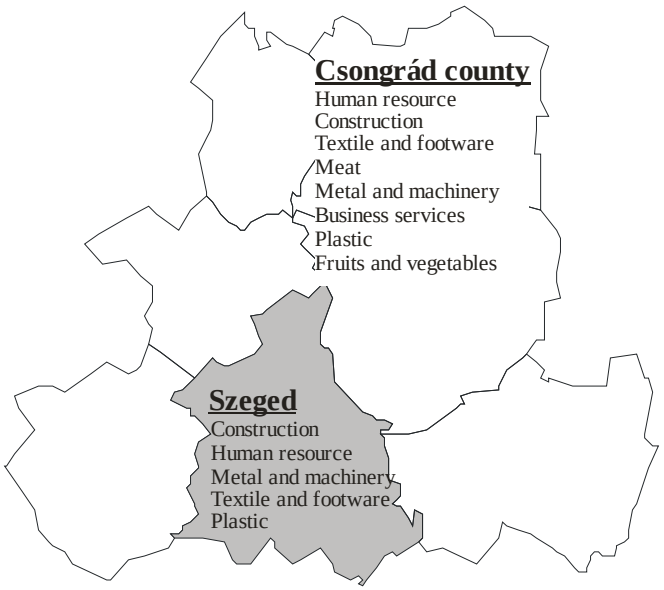
Szeged has much less of a critical mass in any of its potential clusters. Most considerable concentrations are the Construction and the Human Resource Clusters (Table 1). Assumably, on a subregional or municipal level it is not really worth searching for clusters, it is at least the county level, where clusters with a critical mass are identifiable.

An interesting feature appears in connection with Szeged: the centre of the county shows concentration only in those activities, in which the county does so, too. Szeged might be outstanding in activities hardly measureable with the traditional SIC-code based data.

Although the aim of the mapping included the promotion of innovation, too, real innovative clusters have not been recognised. It is true however, that the methodology itself was not favourable enough for innovative clusters. Traditional industries were identified, dominantly in the processing industry (Figure 2). On one hand, it gives the university a clear view about the structure and nature of the region's economy and educational needs, on the other hand the university might find innovative partners and demand in the innovative segments of the clusters identified.

With knowledge of the economic structure and development of the South-Great-Plain Region and Csongrád County, it is supposed to be a region with (potential or latent) traditional, processing industry clusters and drivers of the economy. The university cannot ignore the innovative factor, but realistically one should not expect to find extensive innovative relationships embedded in the region. Although Szeged considers biotechnology and different high-tech activities as a breakout, these are not statistically measureable and are not dominant segments of the economy at present.

Figure 2. Potential clusters of Szeged and Csongrád County



Source: own construction

Education and research are important parts of the regional employment. Consequently, the university promotes the county and the town with its input-effects, as a passive regional role-player. With a future active university strategy the institute will be able to promote the other potential clusters, too.

7. Summary

All regions desire clusters. These economic structures are ideally created spontaneously, however, their development is sought to be supported in direct and indirect ways from various levels. This is a sort of pressure on the regions, any form of clusters or high-tech activities is a value-added feature in the competition for relocating big companies and development resources[9]. Cluster-mapping is a methodology, a tool-kit and process to support presenting a realistic image on the regions. Via the adaptable part of this tool-kit, a detailed but not too surprising picture has been received of the region. It is worth mentioning that the processing industries are dominant as usually in the neofordist or (half-)peripheral regions (Enyedi 1999, Lengyel 2003), but we have to list the activities supporting the

[9] Referring to the motion picture "Analyse this" mentioned in the title of this study, one might as well think that "the Robert de Niro of regions" gets a nervous breakdown because of the pressure and necessity of becoming a high-tech region, regardless of its talents and desires.

development and maintenance of the human resource alongside with the construction industry.

To summarize, the selected industries show a certain concentration / specialization (LQ-indices and the number of enterprises were used to show it), and also growth (through the number of enterprises). It means that the features ascribed to the drivers of the economy, moreover the critical mass behind the shared labour pool and infrastructure is proven in case of the potential clusters. Export contributes to the driver image, and is an atribute when identifying the traded activities, therefore to the range of activities derived from the other indices has been completed by the exporting industries.

This method did not indicate on the 4-digit SIC-code level the following activities appearing in earlier researches and initiatives: heating and thermo-technical activities, the plant breeding part of the agricultural sector (except processing and distribution), a large number of segments of the food processing industry, some areas of the chemical industry, and handicraft (the latter cannot be measured statistically anyway).

Regarding the clusters of the region it is worth considering that the local involvement and embeddedness of the enterprises located in the South-Great-Plain is extremely low (Buzás 2000). Based on this we have to be aware that the dominance in the economic structure of the region does not necessarily mean that a given activity will be the core of a cluster built on spontaneous co-operation and deeply embedded in the local and regional economy. Nevertheless, this should be the way of progress, even through the economy developing activity of the university.

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Quo Vadis Hungarian Spatial and Settlement Policy?

Miklós Lukovics – Tamás Besze

The sum of the possible financial resources at Hungary's disposal supported by the European Union between 2007 and 2013, indicates a historical chance in connection with the fulfillment of the development objectives, especially the spatial objectives in Hungary. The optimal utilization of the financial resources requires a continued decentralization process – started in 1996 but refracted in 1999 – and a strengthening of the regional institutional system. The efficient utilization of the financial resources also requires such a planning mechanism, which considers both the national specialities as well as the international spatial development experiences, and is based on a wide professional and political consensus.

The present paper aims to survey the most important milestones of the Hungarian spatial policy formation, especially the ones of the spatial- and settlement development. Also the evolution process of the Hungarian self government system is going to be explored, principally in regards of the relationship between the municipality development and EU grants. Finally the most important projects of the Municipality of Szeged will be demonstrated.

Keywords: regional policy, spatial development, municipality development

1. Introduction

Since Hungary's accession to the European Union, spatial planning has come more and more into the limelight, because financial aide of the European Union is based on accomplished spatial documents (Rechnitzer–Lados 2004). Ten years ago, the Hungarian Parliament accepted the Act XXI. of 1996. on regional development and physical planning. This was a supreme and complex regulation of spatial development in Hungary (Horváth 1998). Its further importance is, that Hungary was the first among the candidate countries to adopt the legal conditions of the regional institutions relating to the principles and requirements of the European regional policy. According to the act, spatial development in Hungary is based on national and regional planning documents, concepts, programs, and physical plans (Rechnitzer 1998a).

2. Some issues of the Hungarian spatial policy until 1996

Concerning the analysis of the Trianon Treaty, Pál Teleki was the first Hungarian who examined the economic effects of spatial processes (Hajdú 2001). According to him, breaking-up the solid, poly-centric city network of the Hungarian Kingdom would trigger severe issues for the rest of the Hungarian territory. The truth of his statement is confirmed by the fact that nobody could resolve the problem of a Budapest centered, mono-centric Hungary so far..

The first legislative provision in connection with the spatial- and settlement development was the Act VI. of 1937. on physical planning of cities, housing and construction. The law obliged cities to complete city development plans (Sipos 1993), furthermore compelled cities with high level of exactitude to prepare land usage plans and general settlement plans. After World War II, the Institute of Physical Planning (the so called TERINT) was been established in 1949. The general aim of the TERINT was to coordinate socialistic industrialization and town-planning. Additionally, its task was to register all spatial and settlement changes, and to prepare several plans. Its significance might be the completion of the first regional planning works, like the one of Zagyva-valley, Borsodi area, Baranyai area.

As for local legislation, in 1949 and in 1950 the Constitution, and later the first council law introduced a council system that was completely alien to the Hungarian conditions, by copying the soviet model (MKOGY 1950). From the beginning, the major function of this system was to accomplish the central decisions of the white trash dictatorship that aimed to change society and economy mainly with means of polity, leaving little local independence. Similarly to the first one, the Second Council Law in 1954 also rejected the idea of local municipality (MKOGY 1954). There was a decrease in the councils' duties in administration and authority but the councils' spatial and settlement development tasks slightly increased. The councils were regarded as the lengthened arm of the central state organization delegated by the monolithic party-centre. In the so-called dual subservience the centre managed the county by primacy means, the county managed the townships and most of the towns and the township councils managed the villages. This local dependence attached serious lack of local democratism, nominal votings and elections preceding the real free elections. Council boards were politically insignificant, as council leaders, closed council meetings and closed executive board meetings decided on important issues beforehand, and council meetings mostly just accepted these decisions. From the aspect of city development, we cannot disregard that the panel program that started in the second half of the 1960s wasn't based on local decisions, either.

The decree with legal force of 1955. XXXVI. on the regulation of town- and village settlement determined the system of town- and village settlement, and dealt with the notion of regionalism more thoughtfully than ever before. Due to this

legislative provision, the number of regional plans increased significantly from the end of the fifties. In 1965, the National Settlement Development Plan was completed, which surveyed Hungarian settlements and development trends. In 1970, the National Settlement Development Concept was worked out, which was adopted by the Hungarian government after a wide dialog with the local and departmental authorities in 1971. According to the concept, all the settlements were classified into development categories. The financial resources provided for each settlement were dependent on the category of the concrete settlement.

This dual subservience remained in force during the later "reforms" of the council system, the laws did not provide much more local independence. The council system was only the executor of central programmes. But these programmes did not involve local needs that could have given a special image to settlement development and that could have implemented developments in a way that would have fulfilled local needs the most. As local regulation did not have any latitude in other developments either, settlements got poorer and poorer, regardless of their size.

On the whole, the Hungarian spatial policy before 1985 can be characterized with a settlement view instead of a spatial view. This policy was city-centric, which underplayed the role and importance of territorial units. In this period, the spatial policy was strongly centralized in Hungary.

From 1985 until 1996, Hungarian spatial policy can be characterized as a transitional one. The resolution of the Parliament Nr. 12/1980-85. aimed to develop the lagging behind territorial units, so this legislative provision was the first, which declared the spatial view instead of settlement view. In the middle of the eighties, it has been realized, that the development of separated settlements is not efficient, complex territorial units has to be taken into consideration and developed. In the decentralization process of the Hungarian regional policy, the Act LXV. of 1990. on the local governments counts as a substantial milestone, which pronounced the local demand on decentralization.

From 1991 until 1995, spatial development efforts were supported by a separated money fund in Hungary. The Spatial Development Fund had a broadly varied function: to support employment level expansion and economic restructuring in lagging behind regions, to support the creation of crisis management programs on the level of regions and sub-regions etc. It was also emphasized, that during this transitional period the regional policy of the European Union was introduced to Hungary, which started to receive its core principles (Lados 2001), but its effects became perceptible only in the next period.

3. Milestone in Hungarian spatial policy

The adoption of the Act XXI of 1996 on regional development and physical planning meant a turning point in regional planning, institutions, financial and economic regulation and EU-integration. 1996, the year, when the act came into force is the beginning of the third stage of the Hungarian spatial policy. This legislative provision set its regional developments goals, overall objectives – therefore the partition of competences between the Parliament and the government – in compliance with the regional policy of the European Union. This act forms the basis of the Hungarian spatial policy (Rechnitzer 1998a).

The Country Report of the European Union in 1998 gave a very positive evaluation on the Hungarian regional policy, because the adopted act was unique amongst the candidate countries. One of the most important significances of the act was to define and to clear the most important notions of the theme, like region, sub-region, spatial unit, regional development etc. Furthermore the act defined the tools, financial resources and the institutions of regional development. The notion of regional planning was given a high priority also in the preparation for drawing Structural Funds and the evaluation of the country alike.

The act set up the possibility of applying the regional policy of the European Union by containing the most important core principles of the EU's regional policy, like concentration, partnership, additionality, regional applications etc. Furthermore the act fulfills the requirements of justice, equity and solidarity, and the general cohesion objectives of the European Union (Horváth 1998). Dissociation of the institutions into national, regional, and sub-regional level also can be evaluated as a big step in the efforts of decentralization. The act ordered to complete spatial development documents first of all on the level of regions and counties[1]. This is a very important issue from economical view, because foreign direct investment and enterprise development need a well documented background, since spatial documents contain significant information to support investment decisions (for example about externalities).

The progress of the Hungarian spatial policy came to a sudden standstill in 1999. The act XCII. of 1999. on the modification of the act XXI. of 1996. on regional development and physical planning can be evaluated as a withdrawal in the decentralization efforts in spatial policy. Significant changes in the membership

[1] In connection with this point of the act, the following legislative provisions should be mentioned:

- 184/1996. (XII. 11.) Statutory order on the adoption process of spatial development concepts, programs and physical plans.
- 112/1997. (VI. 27.) Statutory order on the information system about spatial development and physical planning.
- 18/1998. (VI. 25.) Departmental order on the contents of spatial development concepts, programs and physical plans.
- 23/2001. (II. 14.) Statutory order on the modification of the 184/1996. (XII. 11.) Statutory order on the adoption process of spatial development concepts, programs and physical plans.

pattern of the Regional Development Councils are on the way back to centralization: the preponderance of ministries, its right of veto, the exclusion of the local economic actors (chambers, Council of Labour), the membership of deconcentrated organizations (Office of Agriculture) are steps towards centralization. The European Union passed strictures on this issue, just as on the inadequate utilization of the financial resources: spatial resources have been used as resource replenishment by municipalities and their institutions so they did not catch their originally intended target group, the enterprises.

The European Union also crabbed Hungary in connection with the NUTS-2 level regions: the defined seven regions did not satisfy the criteria of normative regions defined by the EU: there are not elected, only delegated representatives on regional level, and the Regional Development Councils do not have own financial resources at their disposal.

In 1998, the first National Spatial Development Concept (OTK) was approved by the Hungarian Parliament (Decree 35/1998 III.20. of the Hungarian Parliament). This Concept was the first complex and strategic development document in Hungary, which was the principal document of Hungarian spatial development policy, regional development. It gave orientation for different instruments of regional policy, and formulated guidelines in order to reduce regional disparities. As a framework document it contains the development perspectives of the country and its regions, outlines the long-term regional development objectives and declares the guidelines for the elaboration of various development programs. In addition, the document provided regional planners and stakeholders with the necessary information (OTK 1998).

4. New trends in Hungarian spatial policy

According to the act XXI of 1996.[2], the National Spatial Development Concept should be analyzed every six year. As a result of three comprehensive evaluations on the emergence of the Hungarian spatial development policy and the regional processes of the country, a new concept was elaborated and approved by the Hungarian Parliament at the end of 2005 (Decree 97/2005 XII. 25 of the Hungarian Parliament). The new concept sets up the principles of a more complex spatial development policy, which must be integrated into all other policies. At the same time these policies also should be integrated through the development of regions by the process of decentralization.

[2] The act LXXV. of 2004. on the modification of the act XXI. of 1996. on regional development and physical planning and other related acts went back to the way of decentralization, because it abandoned the preponderance of ministries in the membership pattern of Regional Development Councils. Furthermore this act also established development councils on the level of sub-regions.

The new OTK lays down the spatial perspectives of the country, and the long term objectives in harmony with them. Furthermore it draws up medium-term objectives and spatial priorities, tools, institutional conditions, and contains the targets of the regions.

The new National Spatial Development Concept contains the following innovations in comparison with the National Development Concept of 1998 (Salamin et al 2005, OTK 2005):

- it is strong committed to accelerate and strengthen decentralization and regionalism in Hungary,
- it defines a more complex spatial policy, than ever before: a spatial policy with widespread functions, integrated into the general development policy,
- nearby the objective of decreasing regional disparities also the objective of spatial efficiency (competitiveness) and sustainability comes into the limelight,
- it is founded on cross-border thinking.

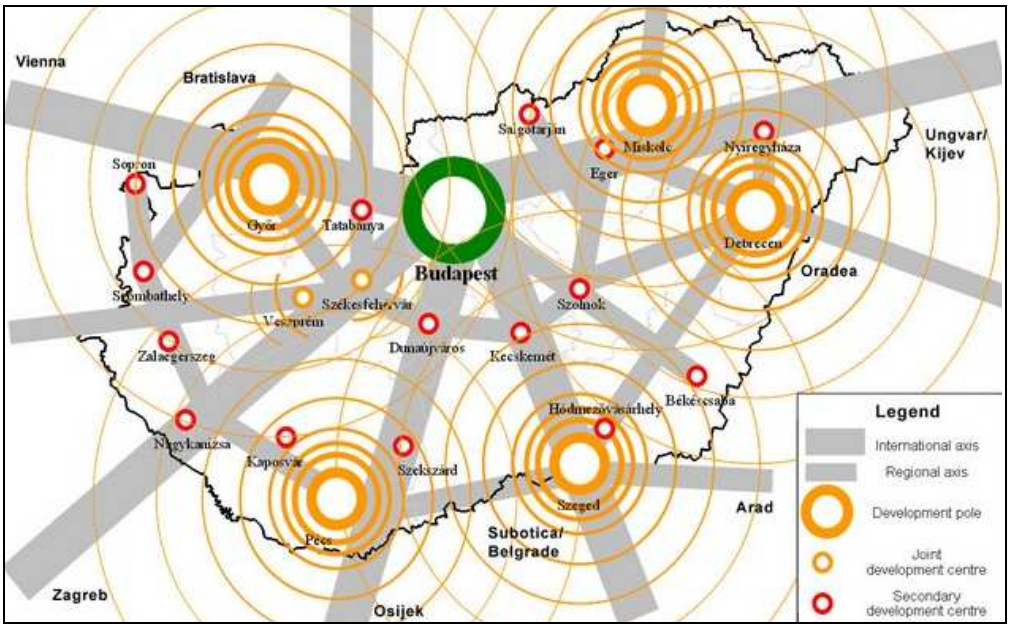
In harmony with one of the most important core principle of the EU regional policy, the idea of subsidiarity, the National Spatial Development Concept of 2005 puts down only such spatial objectives and tasks, which are valid for the country in general. These objectives of the OTK are results of a widespread consultancy process with regional development agencies. The concept provides wide elbow-room in spatial planning for the regions on several aggregation levels, especially for NUTS-2 regions. These territorial units are defined as the primary aggregation level in the decentralized development policy. During the spatial planning process of the NUTS-2 regions the general objectives written in the OTK should be considered compulsory (Salamin et al 2005, OTK 2005).

5. Development poles in the new spatial policy

The National Development Concept (OFK), as an overarching development concept fulfills the role of a country strategy was elaborated in 2005, parallel to the National Spatial Development Concept. Because of this fact, their main findings are the same: both of them define development poles in Hungary. "*… in order to ensure that development is not limited to the area of the capital, the monocentric spatial structure should be resolved. […] The whole country requires development poles to catalyze competitiveness, and which are organic elements of a harmonious, polycentric, cooperative town network system. […] Hungary's development poles are: Debrecen, Miskolc, Szeged, Pécs, Győr, and Budapest*." (OTK 2005). According to the concept, the most important task of the development poles are to facilitate innovation activity and help spreading innovation in the region. They also should contribute to the decrease of regional disparities in Hungary.

The Decree 96/2005 (XII. 25) of the Hungarian Parliament on the National Development Concept and the Decree 97/2005 (XII. 25) of the Hungarian Parliament on the National Spatial Development Concept defined Szeged as a development pole also on the level of legislative provisions with other 4 cities listed in the decrees (Figure 1).

Figure 1. Regional development poles and axes in Hungary



Source: own construction on the basis of OTK (2005, p. 39.)

Consequently, Szeged, as a defined development pole, with some other preferential cities together plays an accentuated role in the new spatial policy of Hungary. From the point of view of our research it also has to be emphasized, that both OTK and OFK highlight the increase of capacity for specialized research and development of the departments that are competent to instigate defined and significant development (OTK 2005). The core competence of the development pole program in Szeged is the biotechnology.

Based on this, in the following part of this paper we are going to concentrate on the city of Szeged. In the next few chapters we will enhance the most important milestones from the history of the Municipality of Szeged, then some of its relationships with the most important institution of the development pole competence, the University of Szeged will be surveyed.

6. Regime change and the evolution of settlement development's local self-governmental legal background

The regime change challenged people not only on a national but also on a local level: in Szeged, just like in all other communities of the country, the first general municipal elections were held in autumn 1990 as a significant step towards developing democracy. It put an end to the council system and new type of local self-governments replaced them, which, contrary to common councils, could be founded in each settlement.

The political necessity of founding local self-governments, which have their own rights, wealth and income sources, met the national and international economic and professional efforts started on this issue several years before. The new legislation overthrew the whole council system, building on municipal traditions and historical values instead. Dr. Balázs Horváth, Secretary of the Homeland of the Antall-government initiated that the Act LXV. of 1990 should include those basic requirements that are contained in the 1985 municipal Charta of the Council of Europe, and that József Eötvös, the Cult and Educational Minister of the revolutionary government of 1848-49 drew up as follows (ETS 1985): „ *We demand the personal independence to be maintained; we demand the decisions that are of interest only for certain segments of citizens, for example a town or the inhabitants of a county, to be made only by those whom these issues concern*!" (MKOGY 1990a)

The major basic requirement and the quintessence of the new local self-government system is municipal independence, changing the local self-governments into owners and economic organizations, which could proceed to settlement development based on local interests.

7. The economic grounds of local self-governments' development sources in the 1990s

The economic background of local self-governments that became legitimate by the democratic elections radically changed in comparison to the council system. At the change of the regime, the Act LXV of 1990 significantly changed the conditions of settlement management and placed it on a new basis.

From this point, local self-governments had their own properties, and could manage their own budgetary incomes and expenses independently. In addition, they could alienate items that had been taken away from the state property and had been given to the municipalities (such as roads, institutions, buildings, barracks etc). It was a milestone for settlement development because settlements suffering from lack of financial sources could use their properties as a collateral when asking for development aids or applying for tenders, or they could even sell, privatize these

properties. Possessing own financial resources, local self-governments were able to decide on their own settlement's actuation and the direction of their development quite independently.

But this kind of independence did not always mean complete independence in terms of development tasks in the first half of the 1990s. The reason for this is that the municipalities' financial operations and their use of sources is strongly controlled: firstly because the budget of local self-governments is part of the public finance, they get most of their financial funds from the state[3]; secondly because in case of other supports financed by the public, the state determines the conditions how these supports can be used, for example earmarked subsidies and allocations[4] based only on national sources, that were significant in this period and that realized several important investments in Szeged in the last few years.

8. The new financial sources of the regime change: privatization incomes, earmarked subsidies, real estate barters

In the years following the regime change, Szeged couldn't see bigger developments due to a lack of equity. Similarly to other local self-governments, the Municipality of Szeged, the county capital of Csongrád County, could experience not only the bright side of wealth growth, but also took on a lot of charges after its own ownership developed. Firstly the establishment costs of municipal institutions was almost an impossible burden for the local authorities. Secondly, the only significant source of income, privatization, which started due to the possibility to alienate the local self-government's properties, meant not only income but also expenses. These properties were often rather devastated buildings and building sites without public utilities, which had to be upgraded before sale. In most cases it meant restoring building and providing building sites with public utilities.

But in terms of town development and town rehabilitation, the undoubted merit of privatization is that the incomes of selling those properties that had been given by the state meant almost the only sources that could finance more significant projects in the beginning of the 1990s. Due to such incomes several building reconstructions were started in the city (e.g. the restoration of Dóm square).

In the following years the local self-governments' independence in decision-making was damaged by the lack of other development sources independent of the

[3] The bigger part of the incomes of the local self governments consist of state assigned taxes, normative contributions of the state budget, local taxes, incomings of its own economic activities and fees (MKOGY 1990b).

[4] According to the Act 1992. évi LXXXIX. the Hungarian Parliament supports some of law defined local investments in order to stabilize the actions of the local self-governments. If a local self-governments fits to the state specialized criteria system it gets the earmarked subsidies automatically. Beyond this adequate the ermarked allocations were available just in competition: in order to get state subsidies local governments have to create competitive project ideas for a ranking list.

budget. According to the Act LXV of 1990. on local self-governments could manage local developments in their own jurisdiction, but without proper financial background they could only implement developments which enjoyed central state support. This statement is confirmed by how the incomes of the privatization of municipal properties (building sites, buildings, etc.) were used, as according to central legislation these incomes could be used only to restore buildings (mainly residential properties), which were almost the only reliable financial background for building restorations besides earmarked subsidies and allocations in the beginning of the 1990s (MKOGY 1990b). It includes the restoration of Szeged's historical centre, which, after the small renovations of the 1980s, appeared only point wise in the beginning of the 1990s, and was limited to certain institutional and residential buildings. From the end of the decade bigger and bigger projects were started with conscious town rehabilitation planning, such as the one billion-forint restoration of Kárász street – Klauzál square, the restoration of so-called 2nd block within Kárász, Somogyi, Kelemen and Kölcsey streets, and the 800 million-forint rebuilding of the dual roundabout at Dugonics square and the transformation of Tisza Lajos boulevard, which were remarkable improvements of the city centre's traffic conditions.

For the sake of using the available sources independently, the local self-government has often tried to find other ways of utilizing its properties to gain alternative economic benefits. After the regime change, the acquired buildings were taken into account not only as properties that could be sold, but they also gave the possibility for different organizations to join economically. The "Universitas property barter programme" that was started in the middle if the 1990s by the local self-government and the university as their first development programme in the middle of the 1990s serves as a good example for that. It meant that the university, which covers the whole of the city's area, and the municipality swaps properties on the grounds of mutual benefits with the approbation of Szeged's General Assembly. József Attila University and Juhász Gyula Teacher Training College, the legal predecessors of Szeged University possessed a notable number of properties SZMJVÖ (2000).

9. Sources appearing with the pre-accession to the European Union (Phare, ISPA)

The city of Szeged started to work out investment concepts based on new sources in the second half of the 1990s. The reason for this was that the basis of Pre-accession to the European Union became available such as PHARE, ISPA and SAPARD. From these, mainly the pre-accession programmes of PHARE and ISPA were significant from the point of settlement development. Since these programmes –

mainly ISPA – supported mostly cohesive investments, the main direction of developments was also limited to remedial projects.

Due to the shift in the direction of the targets of PHARE programmes in 1997, the programme's funds could also be used directly for institutional developments and supporting investment (Flamm Benedek 2003). In autumn 2003, approaching the deadline of using the pre-accession's funds, an application was handed in to restore a square that belonged to the historical part of the city centre of Szeged. Competitive factors started to arise as part of the project as the application included not only rehabilitation, but also creation of workplaces. The reason for this was the establishment of a biomonitoring system at the square, that monitors the pollution level of the air, and to operate this system, experts had to be trained and employed, and other new employees were also hired through cooperation with civil services and the employment centre, who had to look after the renovated park. Thus the idea of partnership, that is a keystone of the grants of the European Union, concretely appears in this 1.1 billion-forint project.

Another important investment of Szeged, which aimed to establish the city's entire sewerage system, was also launched in this period. Hungary's biggest investment of this kind was implemented from a total gross budget of more than 23 billion forints, using sources from Brussels, ISPA funds, and it meant that 253 kilometres of drainage was built altogether in the city and in the neighbouring villages that joined to the programme.

The main aim of ISPA was to prepare the counties awaiting the accession to welcome the Cohesive Fund's supports, and to solve the concrete problems of traffic and environmental infrastructure, that were hindering the accession. So the supporting programme had remedial aims firstly, and not to improve economic competitiveness. We mustn't forget though, that as an indirect effect of this investment, the number of people employed in local construction increased significantly – even if temporarily -, because 80% of the contractors working on this project were local entrepreneurs, this way local employers and employees could also benefit from the rehabilitation, and it also enlarged the budget of the municipality because of the entrepreneurs' local taxes (mainly trade and communal taxes). Besides the restored roads and completed drainage system, a further benefit of the project was the strengthened local entrepreneurs, who could use this work as a reference and who, this way could apply for similar projects in other parts of the country with great chances.

10. Increase in development funds between 2004 and 2006

With Hungary's accession to the European Union on the 1st of May 2004, unprecedented financial sources became available for national and local developments. Between 2004 and 2006 675 billion forints were available for certain

development priorities in the frame of the National Development Concept (NFT). According to the basic aims[5] drawn up in the NFT, there were calls for tenders in five operational programmes (OP): Economic Competitiveness OP, Environment and Infrastructure OP, Agricultural and Rural Development OP, Human Resource Development OP, and Regional OP. From these Operational Programmes mostly GVOP, KIOP, and ROP provided possibility to implement bigger investments. The support rates were around 50-80%, but in many cases raising the 10-15% own funding was also a difficulty. Despite the extended funds, this problem could have discouraged a lot of local self-governments from potential development possibilities, but the Hungarian government established a tender possibility based only on national sources to help the local self-governments. The ministry of Home Affairs has called a tender every year since 2004 "to support local self-governments' own sources for the development tenders of the European Union" and it has supported a lot of local self-governments' development ideas, that gave fund for the own source of a successful application for an operative programme[6].

In 2005 the Association of National Municipalities' Union's standpoint on the T/17700. bill of the 2006 Budget of the Hungarian government also drew attention to the problems of local self –governments' development sources. According to this bill, the extensive reform of local self-governments, that could make the operation of each settlement economical (OÖÉSZ 2005), does not come true again in 2006. According to the starting point and the accepted bill, which was mainly unchanged compared to the original one, there wasn't a change in the duties and jurisdiction, the conditions of management regulations remained basically unchanged, the financial conditions were damaged[7], so for the next budgetary period of the European Union between 2007 and 2013, the ability to finance bigger municipal investments remained a key question of development policy.

11. New dimension: the development period of 2007 -2013

Certain chapters of the presently effective national development document, "The New Hungary Development Plan" (hereafter UMFT) enhanced the development possibilities of local self-governments. The 675 billion-forint fund available in the

[5] The National development Plan (2004-2006) drafts three general goals (competitive ecomomy, more effective human resource and well-balanced spatial development) in order to improve the living standard sin Hungary (NFT 2004).

[6] In the year 2005 a municipality managed project with the name of „Integrated Development of the E-government in Szeged" was granted by the EU. The total project budget was 670 million HUF (appr. 2,3 million EUR). Beyond the 540 million HUF EU grant the municipality got other 78 million HUF as an own source subsidy from the Hungarian Government (SZMJVÖ 2005).

[7] According to the Act of the annual Hungarian Budget in 2005 the local self-governments got 1349,8 billion HUF (approximately 4,49 billon EUR) as state financial source which was half billion HUF less than in the previous year (MKOGY 2005).

frame of NTF got ten times larger in the period of 2007-2013 and it provides a possibility for more specific aims (Table 1).

According to the Decree 96/2005 (XII. 25) of the Hungarian Parliament on the National Development Concept and the Decree 97/2005 (XII. 25) of the Hungarian Parliament on the National Spatial Development Concept defined Szeged as a development pole also on the level of legislative provisions with other 4 cities listed in the decrees. The long term aims of UMTF is broadening employment and ensuring permanent growth. As for the latter one, according to the UMFT Integrated Settlement Development Strategy, the support for the economic growth of the settlements that are development centres predominates mostly in polycentric, cooperative settlement network system (UMFT 2007). To ensure a long term, balanced spatial development, there is a need to compensate the capital's economic dominance and to change the monocentric structure of the country, which they want to establish with functionally assigned settlements and emphasized developments based on technological innovation. This idea was rather weakened later, in the phase of planning and social discussions, but because of the central role of 5 "pole cities" the possibility of some key investments (based mainly on equity) didn't disappear. As a matter of fact, cities that are assigned as competitive poles do play a key role in determining their area's competitiveness with their innovation potential.

Table 1. Operational Programmes of The New Hungary Development Plan (UMFT)

Priorities	**Operational Programmes**	**Financial Sources (billion HUF)**
1. Economic development	Economic Development OP (GOP)	690,0
2. Transport development	Transport OP (KÖZOP)	1703,2
3. Social renewal	Social Renewal OP (TÁMOP)	966,0
	Social Infrastructure OP (TIOP	538,9
4. Environment and energy developments	Environment and Energy (KEOP)	1140,0
5. Regional Development	OPs of the 7 regions of Hungary:	1609,4
	West Pannon OP	
	Central Transdanubia OP	
	South Transdanubia OP	
	South Great Plain OP	
	North Great Plain OP	
	North Hungary OP	
	Central Hungary OP	
6. State reform	State reform OP	140,7
	Electronic Public Administration OP (ÁROP)	
Co-ordination and communication of the New Hungary Development Plan	Implementation OP (VOP)	87,2
TOTAL (billion HUF)		**6875,4**

Source: own construction on the basis of UMFT (2007, p. 132.)

Although UMFT also underlines the importance of settlements and the settlement system from the point of competitiveness in this case, it is probable that these settlements have also come to the front in case of other kinds of project concepts' central and EU funds – usually developing basic settlement functions.

12. Summary

The reform of the institutional system in the Hungarian spatial development takes place very slowly. The institutional system set up for the access was not consequently built on institutions of regional development, which disappointed the regions (Szaló 2006). The effective establishment of the seven NUTS-2 regions has not been achieved yet, though some encouraging efforts happened. §6 of the act XCII of 1999. on the modification of the act XXI of 1996. ordered to set up regional development councils, hereby the regional framework has been defined by legal means. Some competences and tasks have been delegated to regional level, but the regions possess neither elected representatives nor own financial resources, although those later two are very important from the point of view the European Unions definition on regions.

The correct usage of some core principles (decentralization, subsidiarity, partnership) requires the reconsideration of decision-making competencies, to decentralize the power, to strengthen the autonomy of the local communities (Rechnitzer 1998b). The institutional framework of the spatial policy in Hungary is strongly attached to public administration, especially to the counties. Economic development is unfortunately only second priority in the distribution of financial resources, entrepreneurs are not able to enforce their interests. The counties hesitate to be partners of each other, although an efficient spatial policy requires a successful concentration of forces on each territorial level.

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Public Goods, Private Interest and Altruism

Ferenc Mozsár

This study shows through an example of a public good-like commodity, that the market might possibly provide the commodity even when there is no rivalry in its consumption and the exclusion of non-payers is costly. The actions of the market actors motivated by private interest both on the demand and supply side may render public (eg. government) decision unnecessary, and thus the necessary welfare losses associated therewith (like taxation, public choice, allocation of resources, particular interests) can be avoided. I will also show, that altruistic behaviour – which is, in a way quite distant from the logic of the market – does not necessarily enhance efficiency.

Keywords: public goods, altruism

1. Introduction

Economic theory and practical evidences show, that private demand for public goods, which is, the individuals' willingness to pay, and the supply of these goods frequently results in socially suboptimal quantity of these goods. Economic theory, however, clearly suggests possible solution most of the time as well. This solution is typically not a kind of centralised decision mechanism, that appears a plausible solution, but there are generally methods that can be activated, devised by the entrepreneur on the supply side. It is always advisable to consider these methods, as in this case we do not have to calculate with the transaction costs and other efficiency losses linked to the public provision of these goods (costs of taxation, allocative losses in connection with realisation of partial interests). In this short paper I would like to illustrate my above view through an example of an arbitrarily chosen public good-like commodity. As a by-product of this simple model it can also be shown how, under certain circumstances, it does not matter whether self-interested market behaviour is accompanied by altruistic behaviour.

Well-known definitions for a public good mention *non-rivalrous consumption* (Samuelson 1955, Mansfield 1975), *non-excludability* (Fisher 2000, Pearce 1993), *extern effects* (Buchanan – Stubblebine 1962, Cornes–Sandler 1996), *indivisibility* (Stiglitz 2000) of the good and possibly *governmental provision* (Rodda 2001) as differentiating characteristic.[1] I will now take non-rivalry as a sole important

[1] On the notion of public goods in detail see Mozsár (2003).

characteristic of a public good, which also means that congestion will not happen in spite of a growth in the number of consumers. Non-excludability as a frequently mentioned attribute of a pure public good will be handled as a *second condition*, which might go together with the first, but it results in different kinds of problems. It can also characterise private goods, and should be handled differently. A third dimension of the public good problem is whether the good in question is discrete or continuously divisible. In the first case, we only have to make a „yes-no" decision, or more of this kind consecutively, in the other case decision have to be made about the quantity too. In this paper I will investigate a perfectly discrete good, the consumption of which is non-rivalrous, there is no congestion and non-payers can only be excluded at prohibitively high cost.

In this sentence most of the papers that I am aware of would have said that non-payers are *non-excludable*, but the main problem is the *high cost of exclusion*, not the technical impossibility of exclusion. Thus „non-excludability" in reality means, that taking on the cost of exclusion leads to a socially not efficient outcome, since the costs associated with exclusion would mean a greater burden on society than the potential loss associated with solutions allowing free riding (where loss results form suboptimal allocation of resources or form supply provided by the government) or with the altogether failure of supply. „Too costly" exclusion techniques may hinder the market altogether from producing the good. In this case the entrepreneur has to discover or invent less costly excluding techniques. But if exclusion is currently indeed „too costly", the possibility of free riding has to be considered and one should investigate, whether private solutions could possibly lead to efficient outcome under the circumstances.

2. The case of a single potential buyer

In the most simple case there exist *one and only one* consumer whose reservation price exceeds the production cost of the good in question. In such cases it is possible, that this person alone provides the public good by herself. The only condition for this to happen is, that her disutility (envy) resulting from others' free riding should not decrease her *net* welfare from consuming the public good below the production cost of it, and that she should be sure that without her contribution the public good would not be produced at all. In other words, she has to have *perfect information* over the others' willingness to pay. The only rational thing to do for her is to produce the public good, access to which is now the same as it would be with a private good. The positive value others attach to this good now does not play any role, since the good is assumed to be discrete and congestion effects are ruled out.

This kind of solution is does in fact happen frequently in the reality, especially in the case of public goods of smaller value.[2] The probability of this kind

[2] Someone or other from the block will eventually salt the frozen sidewalk.

of solution is higher as the intensity of preferences in the group become more differentiated. Intensity of preferences is often determined by the status, for example by the wealth of the individual, and the more it is differentiated, the more probable it is, that there exist someone in the relevant group whose valuation exceeds the public good's cost of production. It is clear, that the more real estates one has, the higher she values a prospective decrease in real estate tax (as a public good), and the more she is willing to sacrifice to win the decision makers (legislators) to this case. „Small" actors are thus fairly able to exploit the „big" actor or actors, as we shall see later (Olson 1971).

3. More than one potential buyers

The situation is more difficult if there are *more than one* actors in the relevant group, whose valuation exceeds acquisition costs of the public good, because this opens up for them a way to free ride. In this case, it is not totally certain, that the good will be acquired at all (Hindriks–Pancs 2001). Let b indicate the utility of the public good to any consumer, and C the cost of acquisition. Let us assume, that $b > C$ for *every* member of the group! If a member of the group is sure, that *no other* member will provide the public good, it is rational to her to acquire it herself. Her net utility than is $b - C$. If she succeeds in free riding, however, her net utility will be b. The course of action she will take is dependent on the relation between the *certain* $b - C$ and the *expected* b when free riding. Precondition for a successful free ride is the existence of at least one actor in the group, let us call her *altruist* – as opposed to the *egoist* free rider – who is willing to finance the public good unconditionally whenever $b > C$ holds. Let us suppose, that the relevant group is a random subset of a population where the ratio of egoists is $e[e \in (0,1)]$[3].The likelihood that in a group of $n \geq 2$ there is no altruist is than e^n and thus obviously the likelihood of there being *at least one* altruist is $1 - e^n$. If we look at the situation from the point of view of an egoist, than the likelihood of there being at least one altruist among the others is $1 - e^{n-1}$. It is rational for her to abstain from acquiring the public good if

$$b - C \leq (1 - e^{n-1})b \tag{1}$$

For $n = 2$ this is true if[4]

$$\frac{C}{b} \geq e \tag{2}$$

In this case, the likelihood $[\pi(n, e)]$, that the public good will be produced equals to the likelihood of there being at least one altruist in the group.

[3] See (Goeree et al 2002) on the relationship between alturism and group size.
[4] And if it holds for $n = 2$, than it also holds for any group larger than that.

$$\pi(n, e) = 1 - e^n. \tag{3}$$

According to this, the likelihood of actually producing the public good proportional to the size of the group and inversely proportional to the ratio of egoists in the population. The former relationship seems to contradict the results of Olson whose opinion is, that small groups are more successful in providing public goods than bigger ones (Olson 1997), but notice, that in this model the utilities b derived from using the good by the members of the group is independent of the size of the group (as I assumed there be no congestion), whereas in Olson's model the *sum of the member's utilities* $\Sigma b_i(n)$ is constant.

What happens, if the original population is more egoistic, or the cost-benefit ratio *more favourable*? With suitably chosen parameter values the ratio of egoists in the population will exceed C/b, that is

$$\frac{C}{b} < e\,. \tag{4}$$

In this case $b - C > (1 - e^{n-1})$, and since $e < 1$ and $C > 0$, there exist a critical group size n^* so, that

$$b - C > (1 - e^{n-1})b \qquad \text{for every } n < n^* \text{ and}$$

$$b - C \leq (1 - e^{n-1})b \qquad \text{for every } n \geq n^*.$$

Solving the inequation $b - C \leq (1 - e^{n-1})b$ for n one gets

$$n^* = 1 + \frac{\ln(C/b)}{\ln e} > 2 \tag{5}$$

Critical group size is thus bigger *the less favourable* the cost-utility ratio is, and the smaller the ratio of egoists in the basis-population. There are two possibilities:

1. if $n \geq n^*$, then the existence of at least one altruist in the group is very likely, so the dominant strategy for the egoists is not to pay, that is, to free ride. The probability of the production of the public good is the same $(1 - e^n)$ as in the previous case.
2. if $n < n^*$, then one egoist is going to pay, the others are not. Symmetric behaviour is not a possible equilibrium, since we assumed $b > C$, so payment of one single person is enough for the public good to be produced. It is also not a possible equilibrium that no one pays, since $b - C > (1 - e^{n-1})$b. Let us denote with p the probability that a given (egoistic) person will not pay! Who does pay will earn a net utility of $b - C$. Who does not pay will earn net

b utility if someone else does pay, and 0 otherwise. The likelihood that one member of the $n-1$ size group („the others") will pay is $1-(ep)^{n-1}$, which is the sum of the likelihood of „there is at least one altruist" $(1-e^{n-1})$ and „although there are no altruists, at least one of the egoists will eventually pay" $[e^{n-1}(1-p^{n-1})]$.

If $b-C > [1-(ep)^{n-1}]b$ than the probability of one egoist paying will increase, otherwise it will decrease. In equilibrium

$$b-C = [1-(ep)^{n-1}]b,$$

and in that case:

$$ep = \left(\frac{C}{b}\right)^{\frac{1}{n-1}} \text{ for every } n < n^*. \tag{6}$$

The decrease (increase) of altruists is, in this case (when $n < n^*$ and $e > C/b$) offset by the increase (decrease) in the egoists' willingness to pay, thus the right hand side of the equation is constant.[5] The likelihood of the public good actually being produced will be then independent of the level of altruism:

$$\pi(e, n) = 1-(ep)^n, \tag{7}$$

that is:

$$\pi(e, n) = 1-\left(\frac{C}{b}\right)^{\frac{n}{n-1}}. \tag{8}$$

The probability of the public good actually being produced is inversely proportional to the size of the group.[6]

In the former 1) case the smaller the ratio of egoists in the population and the larger the size of the group, the more likely it is, that the public good will be produced. The precondition of a certain production of the public good is the *total absence* of egoists or an infinitely large group. These results signify what *an entrepreneur* should do: she should lower the ratio of egoists within the group or raise the size of the group concerned. In my opinion, the "magnitude" of egoism is directly proportional to C/b whereas the "feeling" of belonging to the concerned group is inversely proportional to it. Lowering the costs of providing the public good, which is a typical task for an entrepreneur, will lower the probability of

[5] As a reminder, e is the ratio of egoists within the population, p is the egoists' likelihood of not paying. A rise in the ratio of egoists means an increase in e and their higher propensity to pay means a decrease in $_p$.

[6] Assuming $C/b = 0{,}5$ the probability of the public good actually being produced is $\pi(e, n) = 0{,}75$ when $n = 2$ and $\pi(e, n) \to 0{,}5$ when $n \to \infty$.

egoistic behaviour, and higher private advantages associated with the existence of the public good (*b*) can raise the size of the group. The private advantages associated with the existence of the public good can be supplemented with various "selective incentives" Olson mentions (Olson 1997). These selective incentives are non collective goods, the individual usage of which is conditional on taking part in financing a public good, and thus can be an effective tool in organising latent groups. In my opinion such private goods that can be used by members of a group can, in addition to their functions mentioned by Olson, induce people to be part of the group, which in turn make them interested in providing the public good that enhances welfare of the group. I do not therefore take the relevant group as given, this is why we can speak here of the "feeling of belonging to a group". It is one of the tasks of the entrepreneur to generate and strengthen this kind of feeling in prospective consumers through informing them, providing complementary goods or in other ways.

In case 2) the more probable the actual production of the public good the smaller the *C/b* ratio, and the smaller the concerned group. In this case the perquisite for the certain production is $C = 0$.[7]

In the above model we cannot reach the reassuring conclusion that under realistic circumstances voluntary contributions can assure the provision of the public good whenever the sum of private valuations is higher than the cost of providing the good. This (ex post) efficiency condition is maybe a too strict one too according to Menezes et al. (Menezes et al 2001). It is in fact not very appropriate to evaluate the "goodness" of an allocation mechanism on a binary (either good or bad) scale. An alternative evaluative method can be, as the aforementioned authors also suggest is to measure the probability of actually providing the public good, once provision is otherwise effective[8].

4. No potential consumer

The situation gets even more difficult, if no member of the group has a high enough willingness to pay as to finance the public good, even though its existence would be Pareto-efficient, that is

$$b_i < C, \qquad \text{for every } i, \text{ and:} \qquad n \cdot b > C.$$

The contribution of any single player is insufficient in this situation to guarantee for her the availability of the public good. Her contribution is than useless

[7] Lower costs will modify the reaction of the players under some circumstances. It can happen, that it lowers willingness to pay, and thus it will not change the likelihood of the public good's production (Menezes et al 2001).

[8] It would be good to use this kind of evaluation in general, whenever the efficiency of allocative systems, market structures are considered.

if not enough other players other than her contribute and meaningless if the public good is financed without her contribution anyway. The real question here is the probability of hers being the pivotal contribution. How probable is it, that the public good will not be produced without her contribution, but it will with it? Let us investigate first the case when $n = 2$, $b_i = 1$ (i = 1,2) and $1 < C < 2$. Denoting c_i the contribution of the *i*-th person to the costs, the public good can be financed if $\Sigma c_i \geq C$.

If the players have *perfect information* regarding the valuation of the others, than any contribution so that $C-1 < c_i < b_1 = 1$ can lead to the efficient outcome, to the procurement of the public good. The symmetric outcome is naturally the $c_1 = c_2 = C/2$.

Considering now the case of less than perfect information, let us assume, that any player values the public good at $b_i = 1$ with a probability of 0,5 and $b_i = 0$ with the same probability. While everyone is perfectly aware of her own valuation, as to the others everyone knows only this probability distribution. Depending on what happens with the contributions paid if the public good is not produced due to the behaviour of the other, two cases can be distinguished (Menezes et al 2001).

a) In the first „game" if $\Sigma c_i \geq C$ the public good will be purchased, but the potentially positive sum $\Sigma c_i - C$ will not be refunded (but will remain the profit of the producer). In the case of $\Sigma c_i < C$, however, the contributions are paid back. This variation is called subscription game. The symmetric Nash-equilibrium in this game is, that everyone contributes $c_i = 0$ if the good is invaluable, and $c_i = C/2$ whenever the good is valued at 1.[9] The outcome will always be Pareto-optimal.
b) In the other game, $\Sigma c_i < C$ is a sufficient condition to prevent the purchase of the good, but the money paid in already will not be refunded. This kind is called contribution game[10]. The contribution of player 1. is obviously zero if $b_1 = 0$. How much is she willing to pay, if she values the good at 1? In case of a contribution of $C/2$ the public good will be purchased with a probability of 50%, which means an expected value of ½, thus the expected net utility is $½ - C/2 < 0$. Maximal contribution from each player is ½, which is not sufficient to finance the public good, as we assumed $C > 1$. The resulting outcome will not be efficient[11].

This simple, two-player model with binary valuations can be generalised to N > 2 players or to cases in which the valuation of the players is characterised by continuous probabilistic variables of known distribution (Menezes et al 2001).

[9] Nash (or Nash-Cournot) equilibrium means, that everyone's choice is optimal, given everyone else's choice. This means, that no one wants to alter her strategy ex post.
[10] Typical examples of this are when the contribution is an unconditional donation or physical work.
[11] Further models that assume non constant contributions in (Menezes et al 2001).

More complicated models bring up many new issues and make lots of new insights, but in our case they all mark pretty much the same path as our above compact model. More general analysis also supports the superiority of the subscription game over the contribution game just as it is confirmed in laboratory experiments. Perhaps our opinion is not fictitious, that in contribution game situations secondary („selective", if you like) incentives like self-esteem or prestige play a greater role than potential benefits from the public good itself. This is suggested by the significant national differences in donation habits. In subscription games, however, the contrary can be assumed.

Let us now assume, that from a group of n at least $1 \le w \le n$ members have to contribute to the production of the public good. For the sake of simplicity let us again fix the amount of contribution at c per person. Denoting with m_n the number of contributors in the group of n, the probability that there is exactly $m_{n-1} = w - 1$ contributors in any group of $n - 1$ (the „others"), that is, the player in question is a pivotal contributor is:

$$prob(m_{n-1} = w-1) = \binom{n-1}{w-1}(ep)^{n-w}(1-ep)^{w-1}, \tag{9}$$

where e denotes again the ratio of egoists within the population, and p the probability that an egoist will not pay. The indifference condition for a given group-member, assuming contribution game is:

$$prob(m_{n-1} \ge w-1)b - c = prob(m_{n-1} \ge w)b\,. \tag{10}$$

Subtracting the right hand probability from both sides and rearranging we get:

$$prob(m_{n-1} = w-1)b = c\,. \tag{11}$$

In the equilibrium:

$$\binom{n-1}{w-1}(ep)^{n-w}(1-ep)^{w-1} = \frac{c}{b}\,. \tag{12}$$

The probability also, that in a group of n only $m < w$ members contribute, and therefore the public good will not be produced is the sum of probabilities $m = s$, $s < w$

($s = 1, \ldots, w - 1$), that is:

$$\pi_w^{nem}(e,n) = \sum_{s=0}^{w-1}\binom{n}{s}(ep)^{n-s}(1-ep)^{s}\,. \tag{13}$$

The probability of the public good being produced is than obviously:

$$\pi_w^{igen}(e,n) = 1 - \pi_w^{nem}(e,n) = 1 - \sum_{s=0}^{w-1} \binom{n}{s} (ep)^{n-s} (1-ep)^s \ . \qquad (14)$$

Because of (6), *ep* is constant, the altruist/egoist ratio again does not affect the probability of producing the public good. This probability will decrease as the group size increases until n^* (Hindriks–Pancs 2001), above that this probability increases. Increase in the number of necessary contributors also decreases the probability of the production of the public good.

5. Conclusion

The task of the par excellence entrepreneur is to discover opportunities by which she is able to enhance net social welfare, and collect reward for her doing so from those who enjoy this enhanced welfare. Every situation commonly discussed under the topic of „market failure" is thus an opportunity to market players. An environment should be created, where the entrepreneur can reach her goal, and at the same time also fullfills her social function („invisible hand").

In this paper we investigated a public good, which is an eclatant example of market failure, and three possible relevant groups. We assumed a public good in the consumption of which – in our terminology: naturally – there is no rivalry, no congestion effect, and excluding non-payers would be socially inefficient due to exclusion costs. We analised a (relevant) group, in which at least one member's willingness to pay exceeds the production cost of the public good, then one in which this holds for more members and lastly one in which the provision of the public good is conditional on common financing.

In the more complicated cases (2. and 3.) we pointed out those factors – cost/benefit ratio, group size, selective incentives – which an entrepreneur could modulate, thus making the opportunity to enhance welfare also an opportunity to earn money. We also pointed out, that in the analised situations the not so market-conform altruistic behaviour do not necessarily enhance the efficiency of the allocation.

Of course most of the public goods that are generally viewed as such can have many other specific characteristics (congestion, excludability of non-payers) that bring up newer problems and call for new solutions. The objective of this paper was solely to show, that these (*private*) opportunities can in fact exist.

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Measuring the Innovation Performance of Hungarian Subregions

Zoltán Bajmócy – Izabella Szakálné Kanó

Today's spatial economic processes are heavily influenced by the conditions of the learning-based economy. In this peculiar framework one of the main drivers of regional change is technological change occurring through the sequence of innovations. Therefore, the interpretation and measurement of territorial innovation capacity has become one of the main fields of interest in regional economics; however, the analyses conducted in lower levels of territorial aggregation raise several methodological problems.

Present paper aims to analyse and evaluate the innovation capacity of the Hungarian LAU-1 subregions on the theoretical basis of the regional systems of innovation. We rank the innovation capacity of the subregions along distinct dimensions and also complexly, then we carry out the classification of the subregions, and we also analyse the spatial regularities of the innovation capacity. In the last chapter we attempt to shed light on the limitations of the applied approach in order to discuss the problems of the usual methods of innovation-measurement and thus to provide possible future research directions.

Keywords: regional systems of innovation, measuring innovation capacity, subregion

1. Introduction

In today's "knowledge-based" or "learning-based" economy there exists a close correlation between innovation capacity and the desired economic processes of the different regions. Through learning and innovation capacity, regions acquire unique resources that are hard to reproduce and help them to perform well in the territorial competition (Storper 1997, Lengyel 2003). Therefore, grasping the innovation capacity (potential) of the different territorial units has become a field of intense research.

Although innovation research is primarily not rooted in regional science (Solow 1957, Nelson–Winter 1982, Inzelt 1998, Marinova–Phillimore 2003, Fagerberg 2005), spatiality has still been closely associated to the study of the innovation process and innovation capacity right from the beginning (Hägerstrand 1952, Moulaert–Sekia 2003, Dőry 2005, Lagendijk 2006).

On the one hand, regional science has drawn attention to the fact that innovation is a spatial phenomenon which largely depends on region-specific resources impossible to reproduce elsewhere (Ács et al 2000, Asheim–Gertler 2005,

Storper 1997). Consequently, the spatial situation and proximity of players represents an important determining factor of innovation (Varga 2009).

On the other hand, it also explored that analysis on the subnational level assumes essential importance when exploring the innovation capacity (Doloreux 2002, Tödtling–Trippl 2005, Hollanders 2006, Lengyel–Rechnitzer 2004), since the innovation potential of a given country may assume some characteristic spatial structure and display significant territorial disparities.

The *present paper* deals with this latter subject area by analysing the structure of national innovation capacity on the level of subregions. The first part of our paper reviews the interpretation possibilities of regional innovation capacity together with the measurement approaches deriving from them. This is followed by introducing the methodology of our subregional analysis and demonstrating the results emerging from the survey.

Our survey focused on various aspects. On the one hand, it aimed to utilize the experience of the most significant Hungarian and international studies that focus on the measurement of the innovation capacity of territorial units. On the other hand, we intended to gain an overall ranking also covering the different subareas that, beyond comparing the performance of the different territorial units, can also be used to identify the relative strengths and weaknesses of a given subregion. Furthermore, we intend to offer a categorization of Hungarian subregions based on innovation capacity. Beyond all that, we analyse the regularities of the spatial structure of subregional innovation capacity, the potential (spillover) effects of neighbouring subregions.

The final chapter of the paper examines the limitations of the applied approach, by which we also attempt to draw attention to some crucial points that represent general problems of the measurement approaches of territorial innovation capacity. This also offers potential future research directions. Finally, we summarize our most important findings.

2. Interpreting and measuring the innovation capacity of regions

The innovation process is closely linked to spatiality. Storper's (1997) concept of the "regional worlds of innovation" alludes to this, while the different territorial innovation models (TIM) unfold the same idea (Dőry, 2005, Moulaert–Sekia 2003, Lagendijk 2006). Therefore, innovation does not merely have a spatial aspect, but the spatial situation (distribution) of the players and the given regional environment exercise an endogenous influence on its outcome (Varga 2009).

Regional science has constructed various concepts (TIM) that aimed to explain the excelling innovation performance of certain regions (and consequently their competitiveness and success). These theories basically provide a description of the peculiar characteristics of successful regions compared to others.

The concept of *regional innovation systems* (RIS), that has assumed special significance among TIM models in relation to explaining innovation capacity, partly follows this tradition. Besides emphasising spatiality, this approach obviously carries the attributes of the system models of innovation as well. Compared to other TIM models, the RIS concept carries one considerable advantage in terms of the interpretation possibility of territorial innovation capacity. The concept of regional innovation systems (similarly to national innovation systems) derives the innovation performance of regions from elements that are more or less present in all regions and differ only in terms of their performance and the frequency of interactions among the elements. This way, by reviewing system elements and their relations we may gain a picture about the innovation performance (potential) of the region[1].

Tödtling and Trippl (2005) describe regional innovation systems as an open formation, the major elements of which are the subsystems of "knowledge-generation and diffusion", that of "knowledge application and exploitation", their system of relations and the policies influencing all these. Similarly to Cooke's (2004) interpretation, they emphasise the social embeddedness of RIS. The RIS concept does have strong institutional and evolutionist economic roots, thus, amongst factors influencing innovation activity, they review the historically emerged local institutional and infrastructural environment, system of rules and relations and mechanisms of interest representation.

Doloreux (2002) also defines regional innovation systems as the total of elements and relations. He classifies the players of the system into four basic categories: companies, institutions, knowledge infrastructure and regional innovation policy. He emphasises interactive learning, knowledge creation, proximity and social embeddedness as most important system mechanisms.

In the course of defining the elements of the regional innovation system (and potential at the same time), Dőry (2005) highlights six categories: R&D activities of enterprises, relations of enterprises, innovation-related services, technology supply, policies and regional environment. Consequently, this approach in fact includes factors similar to those formerly mentioned as well: the system of knowledge creation and exploitation as well as the background conditions and policies facilitating this.

Although it does not always occur in the systematization of RIS elements in an explicit way, yet, recognizing the role of the background factors that enable the learning capacity of players and therefore the continual adaptation capacity of the region constitute an inherent part of the approach. The concept of the so-called "smart" infrastructure (Malecki 1997, Stimson et al 2006) represents a pattern widely used for systematizing these background factors. The "smart" infrastructure

[1] At the same time, we must note that certain authors (similarly to other TIM models) interpret RIS as the collection of attributes that distinguishes certain regions in the course of territorial competition. So according to them, the mere existence of the system elements is not enough to construct a RIS, since it also requires the presence of actual regional (local) among the subsystems (Asheim–Coenen 2005).

embraces physical and "soft" elements as well as (knowledge-intensive) business services, which essentially encourages the learning capacity of the companies in the region.

Consequently, the interpretation of RIS and therefore regional innovation capacity means grasping certain relevant elements and the system of relations existing among them. Available approaches practically emphasize the importance of *knowledge creation, knowledge exploitation, the background conditions enabling or encouraging these ("smart" infrastructure) and the complex system of relations existing among them.* So essentially, when grasping the innovation capacity of regions, reviewing these categories seems effective. Consequently, grasping innovation capacity requires a complex measurement approach.

The majority of practical attempts aiming at the measurement of innovation reflect on this. In the literature we can see two significantly different approaches concerning the area of measuring the innovation performance of territorial units. *One of the schools* (that seems more dominant in Europe) concentrates on quantifying the elements of the innovation system and the relations existing among them. The surveys carried out in the frameworks of the "European Trend Chart of Innovation" belong here: the different Scoreboard reports and the methodological background studies of these (EIS 2007, Arundel–Hollanders 2005, Hollanders 2006, Kanerva et al 2006). Most Hungarian attempts may also be classified to fall in this group: Csizmadia and Rechnitzer's (2005) survey concentrating on Hungarian cities, Kocziszky's (2004) study focusing on subregions in Northern Hungary or the regularly published reports entitled "Innovation in Western Transdanubia" (Csizmadia et al 2008). The strength of these attempts definitely lies in the complex interpretation of innovation – going beyond research and development and its outputs – and the application of the results of innovation system theories, while the problem of the selection and potential weighting of indicators represents their weakness.

At the same time, there exists a substantially *different approach* in measuring innovation capacity, where innovation capacity is reduced to an indicator considered relevant (while the rest of indicators are taken into consideration only indirectly, in the light of the relation to this dependent variable). Porter and Stern's (2003) "National Innovation Capacity" index may represent the best known example of innovation surveys falling in this family. When ranking the innovation capacity of countries, they consider the number of patents registered at the United States Patent and Trademark Office to be the dependent variable. Other indicators are entered in the National Innovation Capacity index based on what type of relation they have with the dependent variable above (in a regression model).

The strength of the approach lies in the relative objectivity of selecting the indicators (based on their explanatory power) and weighting them (weight is provided by the regression coefficient) within the model. The explanatory potential of the indicator and the value of the regression coefficient clearly justify its

inclusion in the survey. However, the weakness of the approach derives from the same aspect, since the selection of a single highlighted dependent variable poses considerable problems; in fact, it equates innovation to invention. Furthermore, it is difficult to find a dependent variable that could apply almost equally well to a wide range of countries (territorial units). This is why the work of Porter and Stern, for example, is subject to a lot of criticism (despite the fact that it is frequently cited).

On the whole, in our opinion the approaches based on system models can draw a much more diversified picture about the innovation capacity of territorial units together with its structure despite their certain weaknesses. Moreover, they reflect the nature of the innovation process much more, and can leave the linear approach of innovation behind. Therefore, our analysis carried out in the present paper is committed to this approach.

3. Methodology

Our analysis provides the comparison (ranking) of the innovation capacity of the Hungarian subregions, their classification and we also examine the regularities in the spatial distribution of innovation capacity. The 168 Hungarian subregions defined by Government Decree 244/2003 constituted the basic *units of the analysis*. Although the presently valid classification defines 174 subregions, the statistical data used by us could not be aggregated according to the new territorial classification in all cases.

The first step of the analysis was the selection and grouping of the set of applicable indicators. In creating the groups of indicators, we strived to provide the building elements of a "typical" regional innovation system in line with the measurement approaches based on the literature of innovation systems. We established three categories, each of which constitutes the basis of a subindex. These are: knowledge creation, knowledge exploitation and the "smart" infrastructure (Table 1).

The indicators of the subindex of *knowledge creation* measure the capacity of creating scientific and technological knowledge. These indicators are widely used; they constitute the elements of most innovation analyses. We must note that several approaches narrowly interpreting innovation do not go beyond this range of indicators; and draw conclusions by equalizing research and development (R&D) with innovation. Since R&D does not necessarily lead to innovation, and innovation does not necessarily presume R&D (OECD 2005), it is essential to develop further categories.

Table 1. Indicator set for measuring subregional innovation capacity

Category		Indicator	
Knowledge creation	1	Number of R&D performing units per 100000 inhabitants	1
	2	Total staff of R&D units per 1000 inhabitants	2
	3	Number of scientists with PhD per 10000 inhabitants	3
	4	Number of teaching staff of higher education institutions per 1000 inhabitants	4
	5	Investments of R&D units per 1000 inhabitants	5
	6	R&D costs per 1000 inhabitants	6
	7	Expenditures of R&D places per 1000 inhabitants	7
	8	Number of patents in a 5 year period per 10000 inhabitants	8
Knowledge exploitation	1	Export sales as a percent of total sales	9
	2	Export sales per inhabitant	10
	3	Number of foreign owned companies per 1000 inhabitants	11
	4	Share capital of foreign owned companies as a % of total share capital	12
	5	Incomes from intellectual properties per inhabitant	13
	6	Percent of companies in NACE 24 and 29-34 divisions within all companies (high and medium tech manufacturing)	14
	7	Percent of companies in NACE 64 and 72-73 divisions within all companies (high-tech services)	15
	8	Percent of companies in NACE 74 division within all companies (business services)	16
	9	Number of knowledge-intensive firms with more than 50 employees per 100000 inhabitants	17
Smart-infrastucture	1	Per cent of employees with university or college degree	18
	2	Percent of white collar workers in leading positions within all employees	19
	3	Number of full-time students in higher education institutions per 1000 inhabitants	20
	4	Number of ISDN lines per 1000 inhabitants	21
	5	Broad band internet access per 1000 inhabitants	22
	6	Registered members of public libraries per 1000 inhabitants	23
	7	Cinema visits per 1000 inhabitants	24
	8	Museum visitors per 1000 inhabitants	25
	9	Tourist arrivals in public accommodation establishments per 1000 inhabitants	26

Note: At indicators 14-16 the sector codes refer to TEÁOR'03. The source of data: TEIR – Hungarian Spatial Development Information System (indicators 4, 9-13, 20-26, reference year: 2007), Hungarian Statistics Office (HSO) Central and Territorial Database (indicators 14-17, reference year: 2005), HSO R&D Database (indicators 1-2. 5-7, reference year: 2007), HSO Census Database (indicators 18-19, reference year: 2001), Hungarian Patent Office Pipacsweb Database (indicator 8, reference year: 2000-2004) and Hungarian Academy of Sciences General Assembly Database (indicator 3, reference year: 2004).

Source: own construction

The indicators included in the subindex of *knowledge exploitation* substantially aim at grasping the characteristics of the private sector capable of exploiting innovations, so on the one hand, it uses indicators like export share or the presence of foreign direct investment, on the other hand, it indicates the share of the knowledge intensive sectors.

The subindex of the *"smart" infrastructure* systematizes the factors that are required for the operation of the performances measured by the two other subindexes. This, on the one hand, means the presence of "talent" and the conditions necessary for its maintenance (e.g. cultural activities, entertainment), the "openness" of the region in a non-economic sense (e.g. the number of visitors) and the utilization of information and communication technologies.

In the course of selecting actual indicators associated with the different subindexes, the sets of indicators included in various former measurement attempts were reviewed[2], taking into consideration the subregional availability of the different indicators. Based on all this, the survey was started with *26 indicators*, eight of which were classified in the subindex of knowledge creation, nine fell in the subindex of knowledge exploitation and another nine were included in that of the "smart" infrastructure.

Since the analysis aims at grasping innovation capacity, we tried to avoid including elements – present in various reviewed analyses (Csizmadia–Rechnitzer 2005, Kocziszky 2004) – that indicate the general income producing capacity of the economy, since this results in confusion in grasping capacities for innovating and capacities emerging from innovation.

Furthermore, it is also important to highlight that all of our indicators measure relativized values; we mostly used indexes that represent the size of the region as the base of projection. The advantage of this lies in the fact that the values of the different subregions become comparable, while its drawback is that it does not measure the absolute concentration of activities, although in certain cases there is a presumable relation between the volume and efficiency of innovation-related activities (Varga 2009).

The second step of the analysis involved the comparation of the innovation capacity of subregions and their ranking. In calculating the different indexes (and providing the rankings this way), we relied on the methodology used in the surveys of the "European Innovation Scoreboard" (EIS) – both the Summary Innovation Index (SII) and the Service Sector Innovation Index (SSII) is constructed in a similar

[2] The Summary Innovation Index (EIS 2007) of the European Innovation Scoreboard (EIS), the Service Sector Innovation Index (Kanerva et al 2006) of the European Trend Chart on Innovation, the EXIS Summary Index (Arundel–Hollanders 2005), the Euro-Creativity Index of Florida–Tingali (2004), the set of indicators of the European Regional Innovation Scoreboard Summary Index (Hollanders 2006), the indicators applied in Csizmadia and Rechnitzer's (2005) analysis of the innovation potential of Hungarian cities and the set of indicators used in Kocziszky's (2004) analysis of the innovation potential of the subregions in the Northern Hungarian region.

way. Our "Subregional Summary Innovation Index" (SRSI) was created through the following steps:

- *Defining the minimum and maximum values* of the different indicators. It was true for almost all the indicators that the data of one or two subregions excelled (usually in the positive direction) compared to the Hungarian average value. Data were considered as outlier if their deviation from the national average was above three times the standard deviation. Outlier data were not taken into account in the course of defining minimum and maximum values (this was needed to prevent the subsequently emerging scale from being too concentrated).
- *Rescaling data*. We deducted the minimum value emerging in relation to the given indicator from each figure, and divided by the difference of the maximum and minimum value. This way each rescaled value falls between 0 and 1. Outlier data received the value of 0 or 1 (depending on the direction of the deviation).
- *Establishing subindexes*. The different subindexes emerge as the arithmetical average of the values of the indicators associated to them. The potential weighting of the indicators may represent a possible step; however, in the course of the analysis – in harmony with the methodology of EIS – emphasis fell on clarity.
- *Developing the SRSI and establishing ranking*. The SRSI is the arithmetical average of the three subindexes. The ranking of the Subregional Innovation Capacity derives from ranking SRSI values in a decreasing order. Index (and subindex) values are values measured on a ratio scale; therefore, they are suitable for grasping the distance from other regions, and comparison with the national average.

Consequently, the SRSI index of the different subregions characterises the region's innovation capacity in a complex way based on a complex set of indicators. The approach goes beyond frequently used analyses focusing on R&D: besides the capacity of knowledge creation, it also characterises the subsystem of knowledge exploitation and the quality of the "smart" infrastructure necessary for operating all these. Therefore, the innovation capacity of regions that have good performance based on the SRSI is generally the result of a complex performance with multiple foundations. At the same time, it might happen that a region assumes a relatively advanced position in the ranking based on the SRSI due to the outstanding value of a given area; therefore, the analysis of performance according to the different subindexes is also required.

The third phase of the analysis consists of providing the potential classification of subregions based on their innovation capacity. This occurred similarly to the method of Csizmadia and Rechnitzer (2005) in their analysis of the

innovation potential of Hungarian cities. Classification took place on the basis of the three subindex values.

We carried out K-means cluster analysis using the standardized values of the three subindexes. The analysis was completed with three, four and five clusters. Classification seemed relatively stable, the increase in the number of clusters led to the further division of certain groups, but no significant change occurred in the members of the different groups. Based on the dispersion of distance measured from the cluster centre, the establishment of five groups resulted in the emergence of most homogeneous (and most easily interpretable) clusters; therefore, this seemed the most supported solution.

In the fourth step of the analysis, we examined the spatial regularities of subregional innovation capacity, that is, whether the data of adjacent territorial units are similar. In fact, we measured spatial autocorrelation with the help of the Moran index on the national level, and the "Local Moran Index" on the subregional level.

The index number proposed by Moran in 1948 called the Moran index measures spatial autocorrelation similarly to the autocorrelation of time series data (Moran 1950, Anselin 1988, Dusek 2004). It is calculated in the following way:

$$I = \frac{M}{\sum_{i=1}^{M}\sum_{j=1}^{M} w_{ij}} \frac{\sum_{i=1}^{M}\sum_{j=1}^{M} x_i w_{ij} x_j}{\sum_{i=1}^{M} x_i^{\,2}}, \text{ where}$$

- M: the number of territorial units, in our case this means 168 subregions,
- x_j: the value of the examined data values associated to territorial unit j, in our case, the value of the different subindexes and the SRSI associated to subregion j.
- w_{ij}: item j of line i of the neighbourhood matrix, its value is 1 if subregions i and j are neighbours, otherwise it is 0.

Since the neighbourhood of territorial units can be interpreted in multiple ways, therefore, various neighbourhood matrixes can be created. In the followings, we used bastion neighbourhood as the basis, which means that w_{ij} received the value 1 if subregions i and j have a shared border area, otherwise the value of w_{ij} is 0.

The size of the pseudo-significance level calculated by the Monte Carlo method and the algebraic sign of the value I define the size of autocorrelation and its direction indicated by the actual Moran I value (Table 2).

Table 2. The interpretation of the Moran Index

Significance	Index value	Interpretation
p < 0,05 és	I < – 0,00598	Strong negative autocorrelation
0,05 ≤ p < 0,1 and	I < – 0,00598	Weak negative autocorrelation
0,1 ≤ p		Autocorrelation is not significant
0,05 ≤ p < 0,1 and	I > – 0,00598	Weak positive autocorrelation
p < 0,05 and	I > – 0,00598	Strong positive autocorrelation

Note: „p" represents pseudo-significance. Index value must be compared to -1/(M-1), which, in our subregional database, has a value of -0,00598
Source: own construction on the basis of Cliff and Ord (1981)

The other index number – closely related to the Moran Index – calculated by us is the Local Moran Index that can be interpreted as the local index number of spatial autocorrelation. These values can be calculated separately for each subregion. In our case, the actual subregional standardized value of the examined innovation index is multiplied by the joint average standardized value of the neighbours of the subregion. If the Local Moran Index value calculated this way is positive, then the given subregion is similar to its neighbours; if, on the other hand, the value is negative, then it is different from them. This way subregions can be divided in five categories based on their comparison to the original standardized index value (Table 3).

Table 3. The interpretation of the Local Moran Index

	Interpretation	Condition
High – High	Both the given subregion and its neighbours have and index values significantly above the average.	Local Moran I > 0 Standardized indicator value > 0 p < 0,05
High – Low	The given subregion has significantly above the average, while its neighbours below the average index values.	Local Moran I > 0 Standardized indicator value < 0 p < 0,05
-	No significant correspondence.	p > 0,05
Low – High	The given subregion has significantly below the average, while its neighbours above the average index values.	Local Moran I < 0 Standardized indicator value > 0 p < 0,05
Low – Low	Both the given subregion and its neighbours have and index values significantly below the average.	Local Moran I < 0 Standardized indicator value < 0 p < 0,05

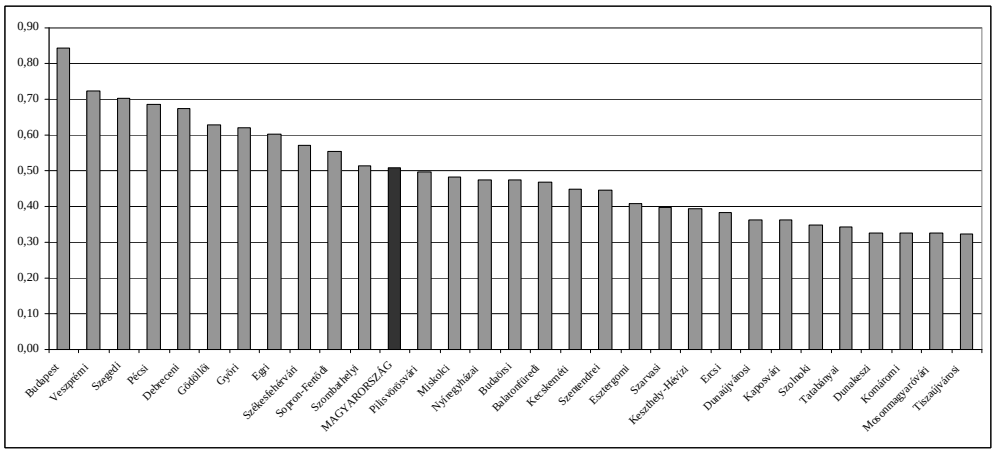
Note: „p" represents pseudo-significance.
Source: own construction

4. The innovation capacity of Hungarian subregions

The innovation capacity of Hungarian subregions is comprehensively introduced with the help of the SRSI and its subindexes, which is followed by the classification of subregions based on innovation capacity and the analysis of spatial regularities.

One of the most general statements that can be made based on the SRSI is that in terms of innovation capacity, *Hungary is characterised by enormous disparities* (Figure 1). There are only 11 subregions with performance above the Hungarian average (0,51 SRSI value). The performance of the other 157 subregions ranges below the average. All this implies that innovation capacity is unbelievably concentrated spatially in Hungary.

Figure 1. Top 30 subregions based on the subregional summary index



Source: own calculations

Out of the first 30 subregions, 18 have cities with county rights; however, the rank is not completely in line with expectations. Although Budapest's first place and the notable position of the Debrecen, Szeged and Pécs subregions meet expectations, the good ranks of the Veszprém, Gödöllő and Eger subregions are rather surprising. Among regional centres, the Miskolc subregion only assumed the 13th position. Out of subregions without cities with county rights the Gödöllő subregion is among the first 10 (ranked 6th), while further five subregions were among the first twenty: the Pilisvörösvár, Balatonfüred, Szentendre, Esztergom and the Szarvas subregions. It is important to underline, that six subregions that have cities with county rights could not make it to the first 30. These are the Zalaegerszeg (31), Békéscsaba (34), Hódmezővásárhely (38), Nagykanizsa (43), Szekszárd (44) and the Salgótarján (51) subregions.

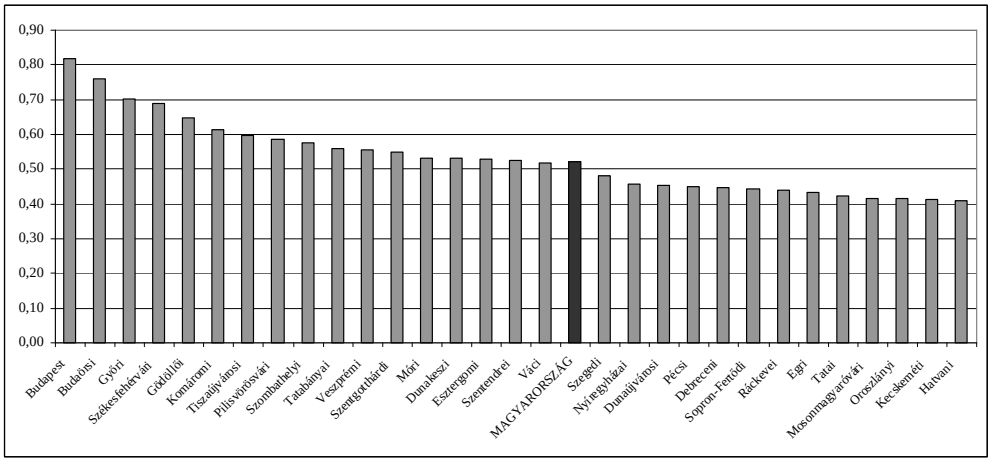
Budapest's SRSI value (0,84) excels compared to the other subregions – although not overtly. It must also be mentioned that Budapest produced outlier

values for 17 of the 26 indicators. Since in this case it automatically received the value 1 (although its performance is higher in reality), the index value carries a downward distortion. Although a relatively large number of subregions showed outlier data related to certain indicators, there were only three further subregions with more than four outlier data: the Debrecen (8), Pécs (6) and the Szeged (9) subregions.

The summarized results are further shaded by the ranks based on the different subindexes. Based on this it becomes apparent that the capacity of subregions is "one-sided" or has "multiple foundations". Budapest has the first position in the rank according to the *subindex of knowledge creation*. The subindex-based ranking reflects well the territorial distribution of major Hungarian universities and the research institute network of the Hungarian Academy of Sciences. This is obviously the consequence of the fact that a significant part of research and development activities is tied to these institutes in our country (In Hungary, the proportion of public financing compared to company financing in R&D is much higher than the European average, although this is far from true compared to the GDP).

The territorial concentration of knowledge creation is even higher than it was in the case of the SRSI. Only 10 subregions exceed the national average value (0.56). The value of the subregion ranking 30th is already below 0.25. In accordance with this, the favourable ranking of various subregions with small city centres is not necessarily accompanied by good performance in terms of absolute value. A favourable relative position may go hand in hand with an unfavourable absolute one.

Figure 2. Top 30 subregions based on the knowledge-exploitation sub-index



Source: own calculations

17 subregions exceed the national average value (0.52) of the *knowledge exploitation subindex* (Figure 2). The ranking based on this element of innovation

capacity is completely different from what would emerge in the case of knowledge creation. The Szeged, Pécs and Debrecen subregions reputed to be innovation centres assumed only positions 18, 21 and 22.

Interestingly, various subregions that excel in attracting foreign direct investment and (partly due to this) in export, also perform well according to the other indicators of the category (e.g. proportion of knowledge-intensive services).

The capacities of knowledge creation and knowledge exploitation (the capacity to manufacture products with high added value that can even be marketed internationally) are spatially divided in Hungary. Knowledge exploitation often does not utilize locally produced knowledge, while the results of R&D are poorly utilized in economic terms. Only few regions showed stable and strong positions in both areas: besides Budapest, the Gödöllő and maybe the Győr subregions may be mentioned.

The ranking deriving from the *"smart" infrastructure subindex* reflects the hierarchy of the national urban network, although with smaller differences. Beyond subregions with large city centres, some subregions with less population that function as significant (cultural) touristic targets could reach a notable position (the Keszthely-Hévíz and Szentendre subregions). At the same time, in order to reach a good position in the rank it was not enough to perform well in terms of one or two indicators. The performance of the above subregions is beyond average in terms of five or six indicators of the category. 21 subregions exceeded the national average value (0.44). It is worth noting that while in relation to knowledge creation, the value of the subregion ranking 30th already goes below 0.25, here only the subregion ranking 58th has the same result.

Differences in ranking are perfectly reflected in measuring the joint movement of subindex values as well. The relation existing between knowledge creation and knowledge exploitation is much looser than that of knowledge creation and "smart" infrastructure values (Table 4).

It is highly important to examine whether innovation capacity is reflected in the differences apparent in economic performance. This also serves to control the results of the survey. Both in terms of the SRSI and the different subindexes, medium or strong positive correlation manifest with the Gross Value Added per capita (GVA) and the income serving as the basis of Personal Income Tax. The connection is a bit looser with the "GVA per employee" and the "profit before tax per employee", that can be interpreted as productivity indicators, although in terms of knowledge exploitation and the SRSI, this also means a relatively strong connection.

In harmony with expectations, the subindex of knowledge exploitation shows the closest connection with income and productivity indicators, while the connection of knowledge creation is the loosest to them. This also proves the relevance that the category of the "smart" infrastructure assumes. The correlation matrix obviously proves that connection of innovation capacity and economic performance, however,

the intensity of the connection implies that the two do not derive from each other in a deterministic way.

Table 4. Correlation matrix of certain income indicators and the subregional summary index

	KCR	KEI	Smart	SRSI	GVA p.c.	PBT	GVA p.e.	Tax
KCR	1,000							
KEI	0,592	1,000						
Smart	0,778	0,631	1,000					
SRSI	0,919	0,823	0,900	1,000				
GVA p. c.	0,476	0,731	0,521	0,641	1,000			
PBT	0,312	0,556	0,297	0,433	0,773	1,000		
GVA p. e.	0,446	0,704	0,498	0,610	0,992	0,773	1,000	
Tax	0,557	0,878	0,644	0,769	0,671	0,451	0,628	1,000

Note: Pearson's correlation. For all values in the matrix: p<0,01. KCR: knowledge creation subindex, KEI: knowledge exploitataion subindex, Smart – Smart infrastructure subindex, SRSI: subregional summary innovation index, GVA p.c: gross value added per capita, PBT: profit before tax per employee, GVA p.e: gross value added per employee, Tax: Personal tax base per inhabitant.
Source: own calculations

Furthermore, another question lies in why innovation capacity shows a more intense connection with the basic values of personal income tax per citizen than it does with work productivity indexes (since as a result of innovations, we would expect improvement in productivity more than increase in incomes). The reason of this – in our opinion – is that it is difficult to separate the maintenance of innovation capacity from the presence of highly qualified "talents" working in positions that are paid better than the average.

Table 5. Final cluster centres in case of five cluster

	Weak innovation capacity	"One-sided" knowledge creating	"One-sided" knowledge exploiting	Medium innovation capacity	Strong innovation capacity
	N=99	N=3	N=38	N=18	N=10
Knowledge creation (Zscore)	-0,4523	2,1776	-0,2007	0,8183	3,1144
Knowledge exploitation (Zscore)	-0,6415	-0,0988	0,7520	0,8990	1,9050
Smart infrastructure (Zscore)	-0,4984	-0,4025	-0,0824	1,5666	2,5479

Source: own calculations

The analysis completed so far already implies clearly that the innovation capacity of Hungarian subregions strongly differ. Some subregions may be

characterised by relatively strong innovation capacity, while the innovation performance of the majority of subregions proves rather poor. Moreover, the different rankings of the different subindexes imply that relatively strong innovation performance can be achieved in various ways, and subregions form groups in this respect too.

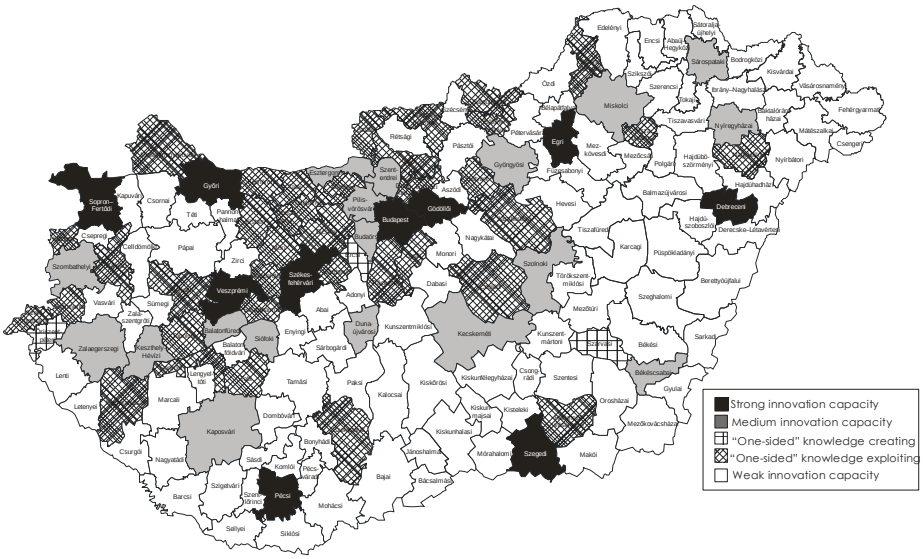
The K-means cluster analysis carried out on the basis of the standardized values of the three subindexes confirmed that subregions can be classified based on their innovation capacity. The *five groups* emerging based on the relation to the criteria defining the cluster can be interpreted relatively easily (Table 5 and Figure 3):

- *Subregions with strong innovation capacity* (10) that, in terms of all three subindexes, perform significantly above the average. The cluster is relatively homogeneous, the standard deviation of the (Euclidean) distances from the centre is 0.38 (without Budapest this value is only 0.33). Although cluster members show good performance in all three categories, their value is the strongest in terms of knowledge creation. The vast majority of cluster members are university towns.
- *Subregions with medium innovation capacity* (18) that have a relative performance in all three areas, but especially in terms of the "smart" infrastructure. Mostly subregions with larger city centres as well as certain subregions of the Budapest agglomeration belong here. This cluster is less homogeneous; the standard deviation of distances from the centre is 0.43.
- *"One-sided" knowledge exploiting subregions* (38) are the ones that show a relatively good performance in terms of knowledge exploitation while they prove rather weak in the other two areas. We must note at the same time that in certain cases this relatively good performance is explained by small size. On the other hand, certain values show such territorial concentration that the good position assumed in the subregional ranking may also cover a weak absolute performance (lagging behind the national average). The cluster is homogeneous; the standard deviation of distances is 0.28.
- *"One-sided" knowledge creating regions* (3) are the ones whose knowledge creating activity is outstanding, while their performance in terms of the other two subindexes is weak. All three subregions belonging in this group have relatively small population; therefore, the relatively strong knowledge creating capability may not assume such significance. Also due to the small number of items, the cluster is highly homogeneous; the standard deviation of distances is 0.10.
- *Subregions with weak innovation capacity* (99) include the majority of the country's subregions. The performance of these is rather weak in terms of all three subindexes. Despite the great number of items, the cluster is homogeneous; the standard deviation of the distances from the cluster centre is 0.23.

The clusters are clearly distinct; classification is obvious in almost all the cases. Compared to the classification deriving from three and four clusters, the cluster of "mediums" was further divided, and the two "one-sided" clusters emerged from it. Furthermore, some formerly strong regions migrated to the cluster of medium strength, and some other formerly weak ones fell into the category of one-sided knowledge creating subregions.

Accordingly, there are only two areas in which the borders among groups are slightly blurred. The best performers among the subregions with medium innovation capacity stand really close to the cluster of strong ones. Consequently, the classification of the subregions of Pilisvörösvár, Miskolc and Nyíregyháza is not perfectly clear. The other similar area involves the weaker members in the cluster of one-sided knowledge exploiting subregions that, based on their performance, are not far from the subregions with weak innovation capacity.

Figure 3. Classification of Hungarian subregions on the basis of their innovation capacity



Source: own calculations

We also examined *what regularities does the spatiality of subregional innovation capacity show*, and whether the data of neighbouring territorial units are similar, since in certain cases, real economic territorial relations may cross subregional boundaries, therefore, the innovation performance of the different subregions may derive from the "spillover" effects of the neighbouring region. The significance of this is particularly obvious in sight of the ring of subregions surrounding Budapest that have a relatively good innovation capacity. Such analysis

may bring us closer to what the "ideal spatial distribution" of a national analysis of regional innovation would be.

Out of the SRSI and its three subindexes only one subindex involves a strongly significant (positive) autocorrelation among its territorial values, and that is the subindex of knowledge exploitation (Table 6). This means that the effect of factors strengthening the extent of knowledge exploitation goes beyond subregional boundaries.

In the case of the rest of subindexes and the SRSI, the presence of such factors surpassing subregional boundaries is not significant concerning the whole country. Still, in the area of Budapest, we can find a coherent system of subregions (Budapest and the Szentendre, Dunakeszi, Pilisvörösvár, Budaörs and Ráckeve subregions) where both subregions and their neighbours have high SRSI values, that is, they fall in the "high – high" class.

Table 6. Results of the global Moran I test

Index	Moran I value	P value	Interpretation
Knowledge creation	-0,0330	0,30	No significant autocorrelation*
Knowledge exploitation	0,3442	0,00	Strong positive autocorrelation*
„Smart" infrastructure	-0,0150	0,44	No significant autocorrelation*
SRSI	0,0622	0,11	No significant autocorrelation*

Note: * Significance level of 5%. Calculation were carried out by Geoda095i.
Source: own calculations

This implies that in terms of innovation capacity, the capital and the surrounding subregions constitute an organic unit, real territorial connections go beyond subregional boundaries significantly here. Results suggest that except for Budapest, there is no other significant innovation centre in the country that would have an innovation "radiation" transcending subregional boundaries (Figure 4).

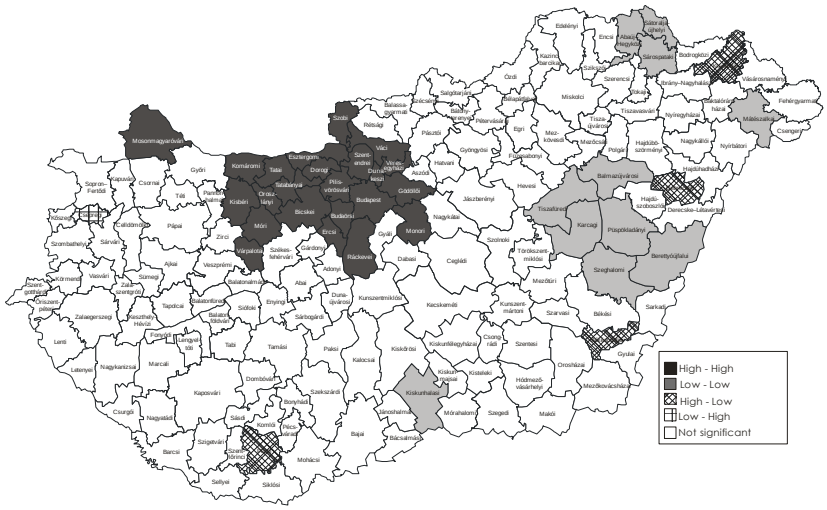
Two phenomena cause the positive spatial autocorrelation of the capacity of knowledge exploitation: the spatial condensation of positive subindex values on one hand, and that of negative (standardized) subindex values, on the other hand. An intense territorial concentration of subregions with a high local Moran index value may be noticed in the area of Budapest ("high – high" class).

On the other hand, two further coherent areas are visible on the map: in the central part of the Trans-Tisza Region, and in North-Eastern Hungary, where both the subregion and its surrounding have low knowledge exploitation subindex value ("low – low" class).

So the spatiality of the knowledge exploitation capacity displays characteristic regularities. The possibility of the presence of a real regional system surpassing subregional boundaries may arise in Central Hungary (at least in terms of knowledge exploitation). At the same time, another important result lies in the fact that in the case of the other two subindexes no significant autocorrelation exists. This is less

surprising in connection with "smart" infrastructure, since the values of this subindex correspond to the city-hierarchy relatively well (and consequently to its territorial appearance too). However, in terms of the subindex of knowledge creation, this definitely implies that the effect of research and development activities (and institutions dealing with research and development) does not go beyond their own subregion.

Figure 4. Spatial dispersion of Local Moran Index in case of the knowledge-exploitation subindex



Note: The figure represents the Local Moran I-Test values at a 5% level of pseudo-significance, by using bastion neighbourhodd matrix. In case of high-high relation, both the given subregion and its neighbours have high "Knowledge-exploitation" Subindex value. Calculations were carried out by Geoda095i.
Source: own calculations

5. Limitations and future research directions

The method applied in our analysis has various limitations – besides others – that are rooted in the general methodology of innovation measurement. Consequently, from the aspect of measuring the innovation capacity of territorial units and the scientific debates related to this, we consider the exploration of such limitations and the provision of potential future research direction to be of vital importance.

A part of the limitations inherent in the applied approach derive from *subnational level analysis*. This more or less characterises all similar measurement attempts, but it does not question the relevance of the method substantially. The difficulties of accessing territorial data generally require giving up complexity to a certain extent. Surveys conducted on a lower territorial agglomeration level are

suitable for the utilization of company level innovation data much less than necessary, or, in the case of using company level data, they limit the scope of the survey to one or two regions (Hollanders 2006, Csizmadia et al 2008). Moreover, in this case, a fundamental result of the theory on innovation systems, namely, grasping the relations amongst the players of the system is excluded from the focus of the studies (or assumes less importance).

Approaches avoid another basic achievement of the literature on regional innovation systems, when they measure and compare the innovation capacity of regions that in certain cases have radically different characteristics based on the same criteria. The different types of the regional innovation system do not infer different measurement approaches. However, for example in a spatially embedded regional innovation system, the analysis of knowledge flows within an industrial branch and among the different branches says much more than, let us say, R&D activity would.

The further limitations of the approach are much more of paradigmatic nature. Related to measuring the innovation capacity of territorial units, an articulate uncertainty is apparent concerning what to measure and *what do we really measure*. On the company level, grasping innovation activity is relatively obvious (for example, in regularly conducted Community Innovation Surveys the criterion of an innovative company is clear). At the same time, the macro effect of micro level innovations may be anything (innovation, sales turnover or market share are not in direct connection). Maybe exactly because of this, it is not the innovation activity of regions, but the *capacity of innovation to contribute GDP per capita growth that is measured*. This approach, however, doubtlessly carries preconceptions: it connects the concepts of economic growth (competitiveness) and innovation capacity ex ante. In the light of this it is not surprising if innovation capacity and economic performance show close connection.

This may also explain low receptiveness to the different measurement of different regional innovation systems, since the capacity to contribute to economic growth as a "global objective function" creates a common denomination for the different regions in terms of measuring innovation capacity.

The general attribute of works aiming at comparing the performance of regions is that they *examine innovation capacity in a relative way (compared to others)*. Annually published rankings (like, for example, "Scoreboard" reports) are based on reviewing performance compared to the average. Therefore, improvement in performance corresponding to the average is interpreted as stagnation (any fallback smaller than the average would be displayed as improvement). In our opinion, this approach is basically rooted in the fact that studies (as already discussed) measure the capacity of innovation activity to contribute to economic growth (competitiveness). Competitiveness is in fact a relative category. Based on its approach, it practically does not matter what our performance is, if compared to others or our formal self it is good or undergoes improvement (Bajmócy 2007). This

approach derives from the general view of mainstream economics and economic policy, according to which greater growth (competitiveness) is better than smaller (practically under all circumstances). In fact, this approach also penetrates the Lisbon strategy that created "Scoreboard" reports. Here, the main question became how much (and in what sense) the member states lag behind one another and especially behind the USA and Japan.

However, all this has another root (maybe going even deeper), and it is *the negligence* (in a certain sense) *of the Schumpeter tradition* in innovation measurement. Schumpeter's "creative destruction" continually deconstructs the old economic structure and replaces it with a new one (Schumpeter 1950). Furthermore, it is not only economic structure that changes, but in "co-evolution" with it, also the infrastructural environment, social relations, interest representation mechanisms and the relation of economy and the natural environment (Polányi 1944, Witt 2003, Kemp et al 1998). One consequence deriving from this process of creative destruction lies in the fact that innovation inevitably has its losers – at least in the short run. Moreover, it makes sense to assume that winners and losers also have different positions in terms of space.

The other fundamental criterion is that the innovation process – since it causes changes in the economy, society and the natural environment simultaneously – requires a great level of continual adaptation from the involved parties. In this case, however, the pace of change is not at all marginal, that is, in a given case, too fast change (outstanding innovation performance) can even result in catastrophic economic and environmental effects.

All this means that in measuring the innovation capacity of territorial units, the application of an approach much more complex than earlier ones seems efficient: integrating social and environmental effects into the measurement and grasping the "manageable" pace of change.

6. Summary

The present paper describes a complex analysis of the innovation capacity of national subregions based on multiple indicators, in the course of which we regarded the concept of regional innovation systems as a point of departure. Based on the complex system of indicators classified in three categories, the analysis goes beyond the approaches that emphasise solely research and development. Beyond knowledge creation, we also reviewed the performance of knowledge exploitation and the "smart" infrastructure necessary for the maintenance of all these.

Based on the results, it becomes apparent that the *territorial distribution of innovation capacity carries enormous disproportions in Hungary*. Innovation capacity is concentrated in few subregions. Besides the few subregions with strong innovation capacity, the group of those with medium innovation capacity is not wide

either. This latter one characteristically embraces subregions with centres that have more population, although there are some exceptions to this.

It is highly important that *knowledge production and knowledge exploitation are spatially differentiated in Hungary*. The number of subregions that excel in both categories is rather small. The effect of knowledge creation typically does not go beyond subregional boundaries, and is only rarely accompanied by local knowledge exploitation. At the same time, knowledge exploitation capacity shows characteristic spatial patterns. In this respect, various subregions are interconnected organically in the surroundings of Budapest.

In the final chapter, we pointed out that the approaches aiming to measure the innovation capacity of territorial units have several limitations that suggest the necessity of reconsidering generally used schemes. Beyond economic indicators, grasping social and environmental changes induced by innovation at the same time seems efficient, since only the joint analysis of the three dimensions could provide a real basis for (the practice of) linking innovation capacity and the desired direction of change in subregions.

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An Analysis of the Spatial Distribution of Knowledge Intensive Services in Hungary

Izabella Szakálné Kanó

In today's developed countries we see an increasing headway of the services sector, while the European Union's regional policy for the period of 2007-2013 places special emphasis on the support of knowledge intensive activities. Therefore, it is important to survey the situation of services with high knowledge intensity in Hungary as well.

Economic activities, and consequently the spatial distribution of knowledge intensive services are influenced by a great deal of factors including disproportions within the given country and externalities like knowledge spillover or market size. The various trends of spatial econometrics and economic geography have developed a series of indicators and index numbers, all of which grasp this phenomenon from different aspects.

My paper aims at applying some of these indicators in Hungary for the analysis of the spatial distribution of knowledge intensive service sectors and their potential clustering.

Keywords: knowledge intensive services, cluster, Ellison-Glaeser's γ index, Moran index

1. Introduction

Today enterprises operating *in developed countries* usually outsource routine and controllable production in order to reduce labour costs and due to the more environment conscious regulation system of these countries, while strategic, financial and marketing activities requiring knowledge and creativity stay in the headquarters of the enterprise. This is partly the reason why the proportion of *services* is prominently high compared to the economic activities of developed countries, and especially the range of *knowledge intensive services* demanding prepared workforce and able to adapt to market changes flexibly undergoes dynamic development.

Since the economic driving force of sectors with high knowledge intensity is especially great, the European Union's regional policy for the period of 2007-2013 also places great emphasis on supporting innovation clusters (CEC 2005). However, it is important to underline that the majority of innovations are not closely linked to R&D activity even in the case of sectors, in which these are most intensely applied (Bajmócy 2007); consequently, it is not enough to use only the intensity of R&D activity to measure knowledge intensity.

Since Hungarian knowledge intensive sectors are able to achieve continuous increase in the area of work productivity even with constant growth in the number of employees (Bajmócy 2007), an important task lies in defining their spatial distribution, where they cluster and what intensity level of factors concentrate them in a given territorial unit.

In the course of analysing economic activity and the spatial situation of active enterprises in different sectors the gathering of enterprises at certain geographical spots is markable. Talking about uneven spatial distribution, we need to distinguish the concepts of *concentration* and *agglomeration*. While the first concept (*concentration*) only covers the difference of values in economic activities measured within a given territorial unit, the second term (*agglomeration*) also considers the spatial relations of these values, the analysis of which must also involve the relations of the different territorial units in terms of adjacency and distance (Lafourcade–Mion 2007). Both concepts may be interpreted on any division level of the examined geographical area (in Hungary, for example, on regional, county, subregional (kistérség) and local levels as well).

After the differentiation of concepts, the indicators developed for their analysis can also be systematized accordingly. In the course of analysis, I used the following indicators and index-numbers:

- Ellison-Glaeser's γ index and the location quotient (LQ) for measuring spatial concentration,
- and the *Moran index* for characterizing spatial auto-correlation, i.e. agglomeration.

The present paper aims at analysing the spatiality of national knowledge intensive sectors. The spatial distribution of knowledge intensive services is examined with the use of statistical methodology, i.e. providing the statistical analysis of the spatial dispersion of these sectors. The second section elaborates on some important considerations of the knowledge based economy. In the following, section three reviews the basic concepts of spatial differentiation and the theoretical background of the survey, then introduces the Hungarian data applied for measuring the spatial distribution of economic activities. Section four discusses the results of the survey comparing the different models built on different assumptions for the total of the 13 analysed knowledge intensive service sectors as well as mentioning the different sectors one by one. Finally, section five describes the summarising observations of the survey.

2. Knowledge based economy

Different sectors are likely to represent different technological standards. In order to display technological differences, OECD and Eurostat surveys usually regard *high-*

tech and *medium-tech* industrial sectors as well as *knowledge intensive services* to be the economic sectors that realize knowledge based economy (OECD 2001). According to this principle, the technological standard of enterprises can be assessed by the two-digit code of their primary activity (Pavitt 1984). Owing to standardized European data collection, Hungary's Standard Industry Code'03 numbers can be adapted for this goal[1] (In the case of services, see Table 1).

Table 1. Knowledge intensive service sectors

Knowledge intensive services	
61 Water transport	71 Renting
62 Air transport	72 Computer and related activities
64 Post, telecommunications	73 Research and development
65 Financial intermediation	74 Other business activities
66 Insurance and pension funding	80 Education
67 Activities auxiliary to financial intermediation	85 Health and social work
70 Real estate activities	92 Recreational, cultural and sporting activities

Note: Sectors 64, 72 and 73 are qualified as high-tech knowledge intensive services.
Source: Laafia (2002, p. 7.)

OECD assessed first the *knowledge intensity* of sectors only in the case of processing industry branches. It defined knowledge intensity based on the R&D data of the sector by comparing the amount of R&D expenditures to the added value of the sector. Later, this method was expanded to also consider *purchased technologies* that were applied through mediator or capital. This way, assessing the *knowledge intensity of the service providing sector* also becomes possible, since these sectors are more technology utilizing than technology producing ones.

3. Basic methodological concepts

The geographical and spatial concentration of economic activities derive from various reasons, with special local characteristics, natural, social and economic factors lying in their background. The concept of *cluster* tries to describe this phenomenon: "*… a geographically bounded concentration of interdependent firms"* (based on Rosenfeld 1997 p. 10., CEC 2002, p. 9.), or in a different way: *the geographically proximate group of enterprises, suppliers, service providers and associated institutions active, competing or interconnected in the same industry sector linked by different types of externalities* (Porter 2003, p. 562.).

The externalities in Porter's definition include increasing returns to size, raw material concentration, transportation costs, knowledge spillover and the effects of market size. Since the reach of these external effects may be significantly different

[1] These data are taken from a database compiled in 2007, therefore, I do not deal with the changes of the Standard Industry Code that entered into force in 2008.

from one another, it is important to map out what extension the spatial clustering of the different economic activities has, or in other words, on what level of spatial division it becomes measurable.

The concept of clusters has rich literature with a wide variety of different approaches; consequently, the scale of *indices* and indicators *defining the degree of clustering* is also rather wide.

3.1. Concentration or agglomeration

All of the concepts aiming to grasp the core of the uneven spatial distribution of economic activities and the local concentration of enterprises – *concentration*, *agglomeration* and *specialization* – examine this phenomenon from a slightly different point of view. Accordingly, the indicators and index numbers serving their measurement also characterize spatial distribution in a different way.

Agglomeration and concentration – the literature of clusters tends to use these two concepts as synonyms, although according to Lafourcade–Mion's (2007) approach, it is recommended to differentiate between these two terms, since the size of enterprises may be closely linked to which form of gathering is realized.

We use the concept of *concentration* when enterprises are clustered in a given region, while these regions can be adjacent or isolated as well. In this case, the only important aspect is whether two enterprises settle in the same territorial unit or not. In such cases the adjacency relations of the territorial units are disregarded.

In the case of *agglomeration*, the spatial bunching of enterprises occur in adjacent territorial units, therefore, in the case of agglomeration, territorial units are not separate and discrete elements of spatial division any more, but interrelated units, where connection is determined by spatial adjacency/distance. In this case, the concept and measurement of spatial auto-correlation emerge.

Figure 1. Concentration and/or agglomeration

3	3	
3	3	

	3	
3		3
	3	

Source: Lafourcade–Mion (2007, p. 49.)

The difference between the two concepts is easy to understand. Figure 1 shows two types of position assumed by 12 companies in 9 territorial units. Both territorial divisions may be called *equally concentrated*, since in the case of concentration, it is not relevant how the nodes of densifying are situated in space compared to one another. However, while in the first case (on the left), companies

agglomerate in space, the second case (on the right) is specifically *not agglomerated*, since the data of the adjacent territorial units are systematically different from one another.

From the aspect of clustering, it is obviously important whether the areas where the economic activity in question is concentrated tend to be adjacent or are situated sporadically in space.

This also means that comparing the degree of agglomeration and concentration in a sector, the *level of spatial division* enabling the measurement of the *range* of factors attracting the different companies of the sector together may be defined.

If spatial distribution corresponds to the figure on the left, then we can conclude that *the range of factors* serving as the reasons of clustering *is larger than* the range of the units in *the* chosen *level of spatial division.* If spatial distribution follows the figure on the right, then the *range* mentioned above *is smaller than* or equal to *the size of territorial units*.

Thus, at least one level above the level of spatial division serving as the basis of measurement, agglomeration may already be grasped as concentration.

3.2. The index numbers of concentration and agglomeration

Based on the above mentioned conceptual distinction, I would like to review the underlying content of calculated index numbers.

In the case of surveys and studies conducted with the goal of economic development and job creation, the degree of clustering is mostly measured with the help of index numbers based on employment data:

The *LQ index* or *Location Quotient* is an indicator often used in the case of employment data. This is the statistical indicator of the under- or overrepresentation of a certain economic activity in the economy of a given region compared to the whole of the national economy (Pearce 1993, p. 336.).

$$LQ_{ij} = \frac{e_{ij} \diagup E_i}{e_j \diagup E} = \frac{s_{ij}}{x_j}, \text{ where}$$

- e_{ij} is the number of employees in service sector i in territorial unit j,
- e_j is the number of employees in services in territorial unit j,
- E_i is the number of employees in service sector I, on the national level, while
- E is the number of national employees in the services.

So

- s_{ij} shows what proportion of the employees of service sector i work in territorial unit j,

- while x_j indicates what proportion of the employees of services (or the total number of employees) work in territorial unit j.

The index number serving for measuring the distribution in the number of enterprises operating in the same field of activity, that is, sectoral (not spatial) concentration is the *Herfindahl-index* (Ellison–Glaeser 1997).

$$H_i = \sum_{k=1}^{N_i} z_{ik}^2 \text{ , where}$$

- N_i : is the number of enterprises operating in sector i,
- z_{ik} : is the proportion of employees per enterprise k in sector i.

Ellison-Glaeser's concentration index (G_i) is the index similar to the well-known Gini coefficient, which measures disparity. It compares the spatial distribution of employment in sector i to the original spatial distribution of employment (Ellison–Glaeser 1997).

$$G_i = \frac{\sum_{j=1}^{M} \left(s_{ij} - x_j\right)^2}{1 - \sum_{j=1}^{M} x_j^2} \text{, where}$$

- M : is the number of territorial units within the examined territorial unit,
- x_j and s_{ij} are values defined together with the *LQ* index.

If the value of Ellison-Glaeser's concentration index (G_i) is low (around 0), the spatial distribution of sectoral employment is similar to the original spatial distribution of employment, while a value close to 1 indicates a high degree of concentration in the sector.

It is recommended to modify the G_i index with the help of the H_i index value, since why a sector is concentrated in one territorial unit may prove a significant question: either because it consists of a single large enterprise or the sector includes many smaller companies that settled in the same territorial unit.

The modified indicator published in the 1990s (Ellison–Glaeser 1997) is called *Ellison-Glaeser's γ_i index,* and is the estimation of the value of correlation between the choice of plant location by two companies operating in any service sector i. For its calculation, two important index numbers, the Herfindahl index (H_i) and the Ellison–Glaeser concentration index (G_i) are used. *Ellison-Glaeser's γ_i index* (EG γ)

$$\gamma_i = \frac{G_i - H_i}{1 - H_i}$$

The *Moran index*, the index number proposed by Moran in 1948, indicates whether the spatial distribution of the currently analysed data values show any kind of regularity, i.e. whether the data of adjacent territorial units are similar. (Moran 1950. Dusek 2004, Lafourcade–Mion 2007) If our data are the territorial values of the Location Quotient $\left(LQ = \frac{s_i}{x_i} \right)$ or some other numerical value indicating concentration like $s_i - x_i$, that results in the territorial auto-correlation coefficient of concentration values.

$$I = \frac{M}{\sum_{i=1}^{M}\sum_{j=1}^{M} w_{ij}} \frac{\sum_{i=1}^{M}\sum_{j=1}^{M} (s_i - x_i) w_{ij} (s_j - x_j)}{\sum_{i=1}^{M} (s_i - x_i)^2}, \text{ where}$$

- M : is the number of territorial units within the analyzed territorial unit,
- w_{ij}: is element j of row i of the adjacency matrix, its value is 1 if territorial units i and j are adjacent, otherwise it is 0.

3.3. Data

Subregional employment data are taken from the 2006 edition of the Hungarian Central Statistical Office's (KSH) Regional Statistical Yearbook and from the data on the population census of 2001 published on the KSH's website, while the data of the different companies derive from the 2007/2 publication of KSH's company informational data register (The Company Code Register – Cég–Kód–Tár) (KSH 2007).

I calculated the data of the different corporate enterprises on staff number, plant location and sector (Hungarian NACE) by association to the relevant subregion. I collected subregional level employment data by sectors (TEÁOR'03, 2 digits) and staff categories.

Exact company *data on staff number* would have been necessary for computing each index number, however, these were not available, so they had to be estimated. For this sake, I presumed that company staff numbers are distributed evenly within the staff categories (Ellison–Glaeser 1997), therefore, when computing the *Herfindahl index* (when the sum of squares is computed), I substituted each staff figure with *the square average* of the values within its own staff category, while in the case of calculating potential total staff number, I substituted each staff figure with the *arithmetic mean* of the values within its own

staff category. Since within staff categories, distribution is usually not even, this simplification may result in a distortion, however, the degree and direction of this is difficult to estimate.

Subregional level employment data derive from the data on the population census of 2001, which data series correlate with the subregional data series of 2006 on the *number of personal income tax payers* to the extent of 0.999, therefore, I used the former one as the basis of my calculations. I estimated the subregional number of employees in the industrial, construction industry and service providing sectors based on these data as well.

I compiled the data of the *subregional adjacency matrix* necessary for computing the Moran index based on the spatial situation of the 168 subregions (kistérség) using *'rook' adjacency* as the basis, which means that element j of row i in the matrix received the value (w_{ij}) 1 if subregions i and j have a shared border area, otherwise the value is 0 (Anselin 1988).

In the empirical analysis, I classified service sectors based on OECD's above mentioned division (Table 1). I took the number of companies belonging here based on their primary activity and the number of their employees as a basis. I used the 168 subregions as territorial units.

4. Results

With one exception, (*70 Real estate activities*[2]), I defined the index numbers of spatial concentration (EG γ) and agglomeration (Moran index) for two different cases for each knowledge intensive service sector listed in table 1: taking data on Budapest into consideration and without Budapest, due to two important reasons. On one hand, the determining social and economic power of the capital is obvious, nevertheless, in statistical terms, the fact that the majority of institutions concentrated in Budapest (for example, institutions of national importance) occur only in Budapest's statistical data in spite of also serving the rest of the country *may be defined as a distortion* (Lukovics 2007). On the other hand, Budapest is included in all territorial divisions – whether local, subregional (kistérség) or county level – as one unit, although the approximately 1.7 million inhabitants represent 17% of Hungary's population, therefore, this can also be regarded as a distorting factor.

4.1. Concentration

The value of *Ellison-Glaeser's γ index* can take its value in the interval [-1,1]. *Its negative value* shows the sparseness of the sector (in this case, companies' choice of plant location is not random, what is more, they try to settle as far from one

[2] I left out service sector *70 of real estate activities* from the survey because in the absence of capacity, the analysis of the sector was not possible with my methods.

another as possible), while in the case of *positive values*: values between 0 and 0.02 indicate weak concentration, between 0.02 and 0.05 they show moderate concentration, while values over 0.05 suggest strong concentration. Based on the value of Ellison-Glaeser's γ index, I classified sectors in the following categories. If

- $\gamma < 0$, then the sector is spatially sparse;
- $0 \leq \gamma < 0.02$, then the sector is weakly concentrated;
- $0.02 \leq \gamma < 0.05$, then the sector is moderately concentrated;
- $0.05 \leq \gamma$, then the sector is strongly concentrated.

Table 2. Ranking of knowledge intensive services compared to the spatial distribution of employees based on Ellison-Glaeser's γ index (concentration, 2007)

Including Budapest			**Excluding Budapest**		
Sectors	EG γ	Classification	Sectors	EG γ	Classification
62 Air transport	-0.0115	sparse	66 Insurance and pension funding	-0.0337	sparse
61 Water transport	-0.0015		61 Water transport	-0.0066	
85 Health and social work	0.0022	weakly concentrated	74 Other business activities	0.0013	
74 Other business activities	0.0071		85 Health and social work	0.0017	
80 Education	0.0351	moderately concentrated	71 Renting	0.0027	
71 Renting	0.0453		67 Activities auxiliary to financial intermediation	0.0033	
92 Recreational, cultural and sporting activities	0.1361	strongly concentrated	92 Recreational, cultural and sporting activities	0.0034	weakly concentrated
73 Research and development	0.1787		65 Financial intermediation	0.0046	
72 Computer and related activities	0.1944		80 Education	0.0057	
67 Activities auxiliary to financial intermediation	0.2087		72 Computer and related activities	0.0100	
64 Post, telecommunications	0.2129		73 Research and development	0.0153	
65 Financial intermediation	0.2685		64 Post, telecommunications	0.1037	strongly concentrated
66 Insurance and pension funding	0.3360		62 Air transport	0.3706	

Source: own calculations

Table 2 includes the ranking of the 13 examined knowledge intensive service sectors in terms of concentration determined on the basis of the *Ellison-Glaeser's γ indices*.

On the basis of spatial concentration, it can be stated that the majority of knowledge intensive service sectors, namely, 9 out of 13 may be called at least moderately concentrated, and this great degree of concentration is mainly due to Budapest, since upon omitting its figures, only two sectors remain strongly concentrated (61 *Air transport* and 64 *Post, telecommunications*), while the rest only qualifies as moderately concentrated at the most.

Table 3. Ranking of knowledge intensive services compared to the spatial distribution of employees based on Moran index (concentration, 2007)

Including Budapest			**Excluding Budapest**		
Sectors	Moran index	Auto-correlation	Sectors	Moran index	Auto-correlation
85 Health and social work	-0.0791	strongly negative	80 Education	-0.0603	strongly negative
65 Financial intermediation	-0.0343		65 Financial intermediation	-0.0606	negative
66 Insurance and pension funding	-0.0288		74 Other business activities	-0.0108	none
67 Activities auxiliary to financial intermediation	-0.0224		66 Insurance and pension funding	-0.0062	
80 Education	-0.0156	negative	71 Renting	0.0006	
74 Other business activities	-0.0046	none	64 Post, telecommunications	0.003	
73 Research and development	-0.0012		85 Health and social work	0.0102	
92 Recreational, cultural and sporting activities	-0.0002		61 Water transport	0.0044	positive
61 Water transport	0.0031	positive	73 Research and development	0.0322	
72 Computer and related activities	0.0093	strongly positive	67 Activities auxiliary to financial intermediation	0.0362	
62 Air transport	0.0109		62 Air transport	0.0181	strongly positive
71 Renting	0.0262		92 Recreational, cultural and sporting activities	0.0653	
64 Post, telecommunications	0.0285		72 Computer and related activities	0.1436	

Source: own calculations

4.2. Agglomeration

In the case of the *Moran index*, it is impossible to determine the auto-correlation level of the sector's spatial distribution based on values only. For determining this, the (estimated) distribution defined using actual concentration values, with the help

of the *Monte Carlo method* is also necessary. The *Geoda 0.9.5-i software*[3] developed by *Luc Anselin* is suitable for completing these calculations, therefore, with its help it is possible to determine the spatial distribution of the given service sector with a preliminary defined significance level:

- with strongly negative auto-correlation;
- with negative auto-correlation;
- with no auto-correlation;
- with positive auto-correlation;
- with strongly positive auto-correlation.

Table 3 includes the ranking of sectors in terms of agglomeration provided on the basis of the Moran index. Based on the index number of agglomeration, sectors are divided, *positive auto-correlation* occurs *in 5 out of 13 sectors*, while this index number is distorted (in the direction of positive auto-correlation) in the event if there are a lot of adjacent areas "empty" in sectoral terms, that is, having low employment level. This result is not surprising, since concentration measures the effect of forces having narrower range, while agglomeration also assesses the effect of forces going beyond area borders. Therefore, it would be worth conducting the survey on the *local level* as well.

4.3. The different sectors[4]

According to the results displayed by the tables, knowledge intensive service sectors show a rather mixed picture in terms of concentration and agglomeration. Figures 2 and 3 indicate how sectors can be classified along these two dimensions.

In order to make the typization of examined service sectors possible, I selected some of the 13 sectors that I will introduce in more detail now.

In the case of sectors *61 Water transport* and *62 Air transport*, based on the values of the γ index number, we find that the choice of plant location by enterprises operating in these sectors does not or only slightly depend on other enterprises' choice of plant location, and if it does depend on it, instead of attractions it is rather repelling forces that lie in the background. On the other hand, the values of the Moran index indicate very strong spatial auto-correlation, which in this case is not the consequence of an attracting force going beyond subregional borders, but rather the relatively low number of enterprises operating in the sectors (104 and 110), since this way, many subregions have low s_i - x_i value similar to their neighbours.

If data on Budapest are excluded from our calculations, the two sectors behave in different ways; the index values of sector 61 *Water transport* display a similar picture to the case when Budapest was included in the calculation, while sector 62 Air transport shows strong spatial concentration. The reason for this may

[3] The software can be downloaded free of charge from http://geodacenter.asu.edu/software/downloads.
[4] Only some sectors are discussed in more detail here.

be that the very few smaller enterprises of the Air transport sector operating in the countryside are concentrated in some subregions; while enterprises located in Budapest take up the majority of the whole sector (2102 of 2369 people are employed by companies with plant location in Budapest).

Figure 2. Results including data on Budapest

Concentration	Spatial auto-correlation: strong negative	weak negative	none	weak positive	strong positive
strong	65; 66; *67*		*73*; 92		64; 72
medium		80			*71*
weak	85		74		
sparse				*61*	*62*

Source: own calculations

Figure 3. Results excluding data on Budapest

Concentration	Spatial auto-correlation: strong negative	weak negative	none	weak positive	strong positive
strong			64		*62*
medium					
weak	80	65	*71*; 74; 85	*67; 73*	72; 92
sparse			66	*61*	

Source: own calculations

In the following, I will introduce the results of three knowledge intensive service sectors different both in terms of index number values and from Budapest's aspect.

4.3.1. Activities auxiliary to financial intermediation (67)

Every service provided in close relation to financial intermediation falls in this service sector (KSH 2003).

In the case of considering data on Budapest, enterprises' choice of plant location in the sector is

- strongly concentrated in space $\gamma = 0.2087$,
- with strongly negative auto-correlation $I = -0.0224$,
- the sector is scattered $H = 0.0908$.

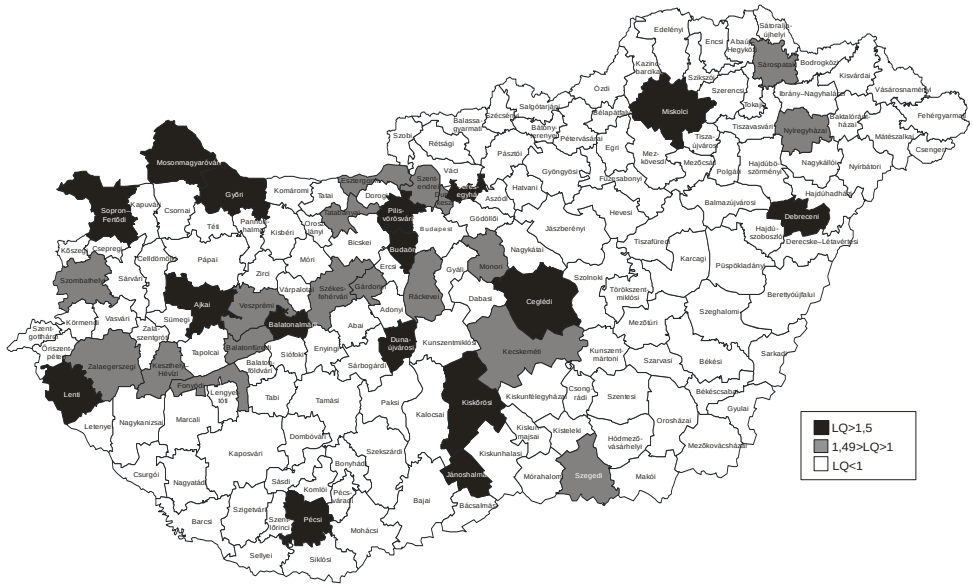
If, on the other hand, we disregard data on Budapest, then enterprises' choice of plant location is

- weakly concentrated in space $\gamma = 0.0033$;
- with positive auto-correlation $I = 0.0362$;
- the sector is strongly scattered $H = 0.0014$.

The comparison of index values and the analysis of different subregional *LQ* values lead us to the following conclusions.

Budapest's influence is especially great, since according to the result of the calculation including its data, only the capital has an *LQ* value higher than 1.5, the same value of all the other subregions is smaller than 1. Consequently, enterprises' choice of plant location is concentrated mainly in Budapest that can be interpreted as a single island[5].

Figure 4. Distribution of *LQ* values in sector 67 Activities auxiliary to financial intermediation according to subregions, excluding data on Budapest



Source: own calculations

If calculations are completed *without the data on Budapest*, the picture becomes much more differentiated (Figure 4). Distribution of *LQ* values in sector 67 of activities auxiliary to financial intermediation according to subregions, excluding

[5] That of Budapest is the only black subregion in the LQ map computed with data on Budapest, the rest of subregions are white.

data on Budapest). Relatively many enterprises operate in the sector – 5531, out of which 1970 are situated in Budapest.

In the country, we can find enterprises with fewer employees that are *concentrated,* although weakly. Concentration mainly occurs in adjacent areas; consequently, there is also *evidence of agglomeration*, so factors go beyond subregional borders.

This activity is mainly *concentrated* in the subregions of Győr – Sopron – Mosonmagyaróvár, the one surrounding Budapest and those of Pécs, Debrecen and Miskolc. The two biggest *differences* in concentration can be observed between the Békéscsaba subregion and its environment (high – low), and the Szeged subregion and its surroundings (high – low).

4.3.2. Renting (71)

Longer term Renting of machinery and equipment without operator and of personal and household goods (KSH 2003).

In the case of considering data on Budapest, companies' choice of plant location is

- moderately concentrated in space $\gamma = 0.0453$;
- with strongly positive auto-correlation $I = 0.0262$;
- the sector is strongly scattered $H = 0.005$.

If, on the other hand, we disregard data on Budapest, then enterprises' choice of plant location in the sector is

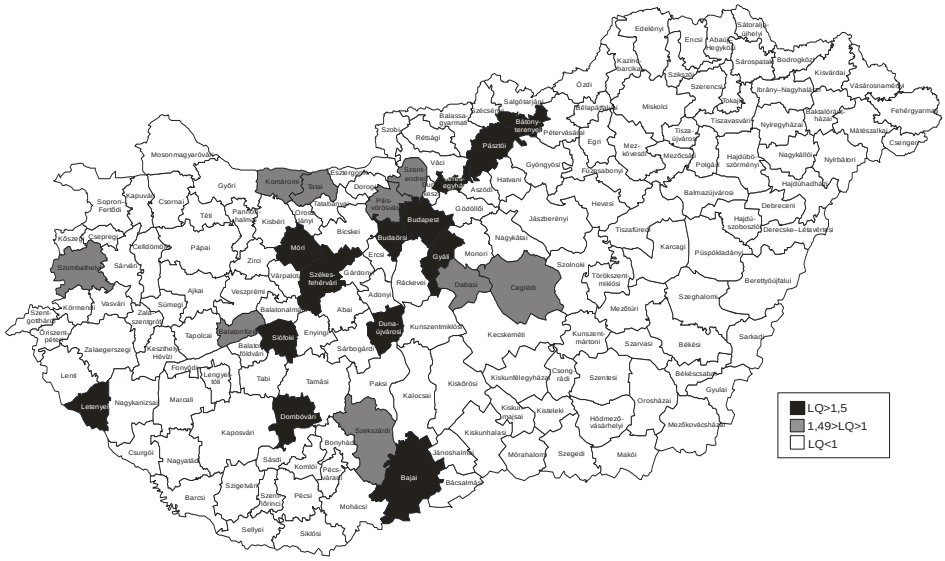
- weakly concentrated in space $\gamma = 0.0027$;
- with no auto-correlation $I = 0.0006$;
- the sector is strongly scattered $H = 0.0079$.

The analysis of the *LQ* values of the different subregions demonstrates that the picture including data on Budapest is similar to the results calculated without these values. The only major change is that while in the former case, *Budapest and the surrounding subregions* similarly have *high concentration*, which also occurs in auto-correlation values, so this activity is *agglomerated* around Budapest, without data on Budapest, with a significance level of 5% there is no auto-correlation any more – so the *Renting* sector does not have agglomeration in the rest of the country.

Disregarding data on Budapest does not bring any great change in the map displaying *LQ* values either, only gives a slightly more complex view (Figure 5 and Figure 6).

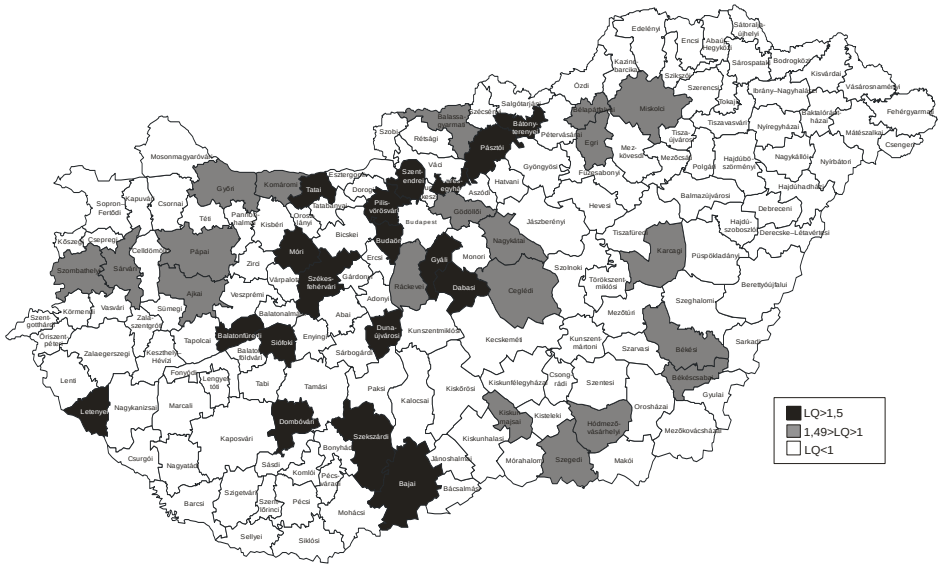
There are 2267 enterprises in this sector, 844 of them are situated in Budapest. Here, Budapest is followed by the subregions below that may be emphasized due to a greater degree of concentration: Veresegyház, Budaörs, Székesfehérvár, Dunaújváros, Gyál, Siófok, Baja, Szentendre, Szekszárd and Pilisvörösvár.

Figure 5. Distribution of *LQ* values in sector 71 Renting according to subregions, including data on Budapest



Source: own calculations

Figure 6. Distribution of *LQ* values in sector 71 Renting according to subregions, excluding data on Budapest



Source: own calculations

It is important to underline the existence of areas that prove especially "empty" from this sector's aspect: these mainly include the surroundings of the Pécs, Debrecen and Nyíregyháza subregions.

4.3.3. Research and development (73)

This sector includes three types of scientific research and development: basic research, applied research and experimental development (KSH 2003).
In the case of considering data on Budapest, companies' choice of plant location in the sector is

- strongly concentrated in space $\gamma = 0.1787$;
- with no auto-correlation $I = -0.0012$;
- however, the sector is strongly scattered $H = 0.0054$.

If, on the other hand, we disregard data on Budapest, then enterprises' choice of plant location in the sector is

- weakly concentrated in space $\gamma = 0.0153$;
- with positive auto-correlation $I = 0.0322$;
- however, the sector is scattered $H = 0.0106$.

In the case of the *research and development* sector, various changes are apparent in index values if data on Budapest are excluded; auto-correlation grows, while the γ value decreases.

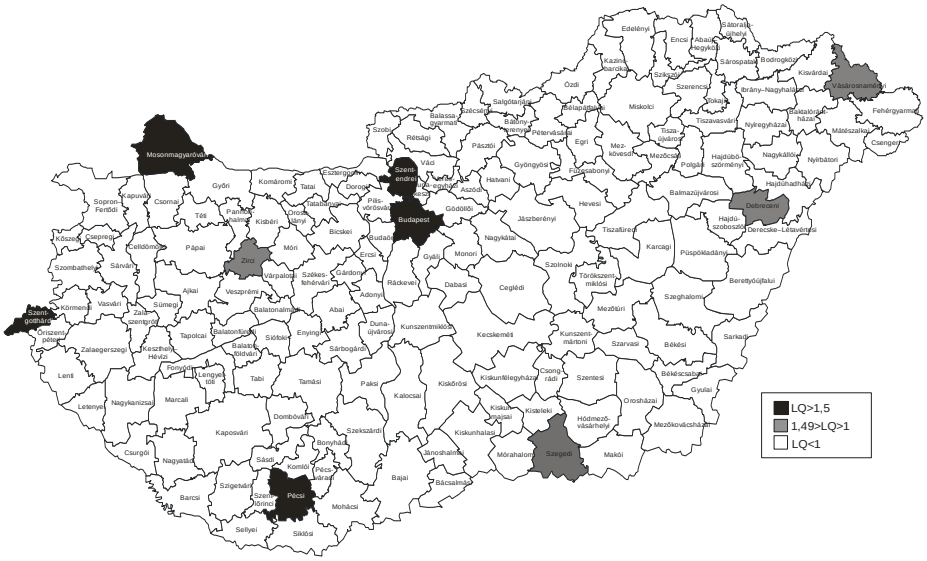
This means that in the choice of plant location made by enterprises operating in the *research and development* sector, an attractive factor going beyond subregional borders can clearly be detected. The development of some nodes is the result of this: such agglomeration points include Budapest and its surroundings like the Szentendre, Budaörs, Pilisvörösvár, Vác and Gödöllő subregions as well as the subregions of Mosonmagyaróvár and Győr.

Disregarding data on Budapest brings some change in the map displaying *LQ* values, the number of subregions having an *LQ* value higher than 1.5 increases considerably (Figure 7 and Figure 8).

Furthermore, the value of the Moran index is significantly increased by the fact that no enterprise with the main activity of R&D operates in 69 subregions, many of which are adjacent.

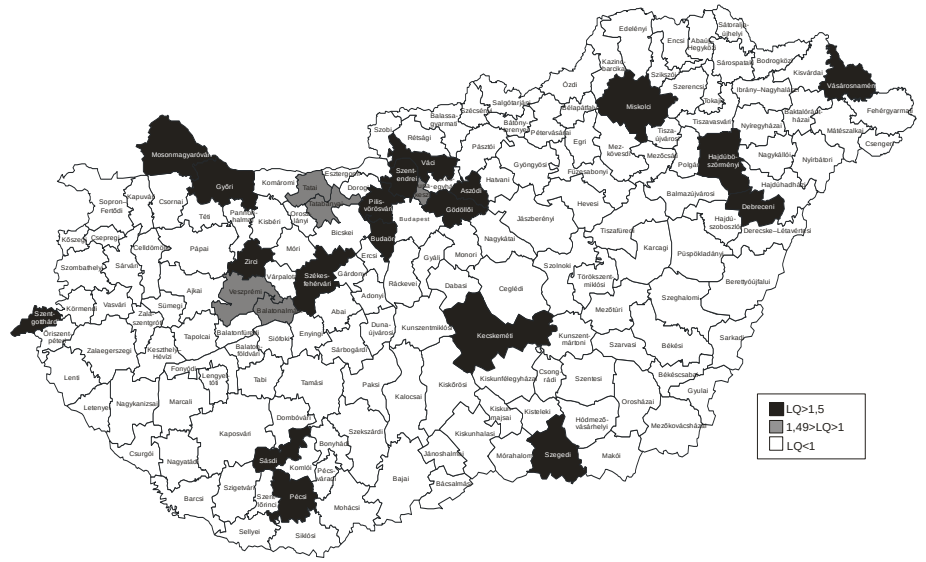
2547 enterprises are present in this sector, out of which 1402 are located in Budapest. Moreover, the subregions of Pécs, Debrecen, Szeged, Miskolc, Kecskemét, Székesfehérvár and Veszprém may also be mentioned.

Figure 7. Distribution of *LQ* values in sector 73 of research and development according to subregions, including data on Budapest



Source: own calculations

Figure 8. Distribution of *LQ* values in sector 73 of research and development according to subregions, excluding data on Budapest



Source: own calculations

4.4. The boundaries of the survey

The above applied index numbers and indicators represent useful help in analyses aiming at the measurement of agglomeration and concentration, however, it is important to underline that final conclusions cannot be drawn based on only these values. In the following, I would like to introduce the limitations of my survey:

1. Spatial division: Since I completed this research on the subregional level, my results can only show the presence and range of factors that occur on this level of spatial division, therefore, it would be useful to conduct the survey on the county level as well.
2. Absolute or relative concentration: *LQ* values mean the quotient of s_i/x_i, while both the Moran index and Ellison-Glaeser's γ index can be calculated on the basis of $s_i - x_i$ values. The former one measures concentration along the subregion's own employment level, therefore, it is relative, while the latter one measures the absolute flow (to or from) of national employment. This is why the use of both is recommended in the survey, and results must be interpreted accordingly.
3. Distortion of index numbers: Since no exact data on employment were available, only the classification of companies in terms of staff number categories, I had to assess these. This may represent a significant degree of distortion in the value of index numbers.
4. Agglomeration – is it? Behind the high value of the Moran index there may not surely lie real agglomeration; it is possible that the value increased due to the concentration of the sector in adjacent subregions with high population, or the existence of adjacent subregions that, however, have especially low employment in the sector and are "empty".

5. Summary

Based on the frequency distribution of index numbers and values included in the tables, surveying the concentration of knowledge intensive sectors suggests that knowledge intensive service sectors display a rather mixed picture in terms of concentration and agglomeration.

Based on the index number of spatial concentration (Ellison-Glaeser's γ index), it can be stated that the majority of knowledge intensive service sectors (9 out of 13) may be called at least *moderately concentrated*, and this high degree of concentration is due to Budapest, consequently, Budapest is the subregion where these knowledge intensive service sectors are present in higher concentration compared to the rest of service sectors.

However, based on the index number of agglomeration (Moran index), sectors prove more divided, positive auto-correlation can be found in 5 of the 13 sectors.

This result is not surprising, since concentration measures the effect of forces having narrower range, while agglomeration also assesses the effect of forces going beyond area borders. Therefore, it would be worth conducting the survey on the county level as well.

The so-called Budapest-effect is very high both in the measurement of agglomeration and of concentration.

Based on the *LQ* indices of knowledge intensive sectors and the values of the Moran index also examining the effects of adjacency, it can be concluded that these sectors are less clustered in Hungary. The value of $LQ > 1{,}5$ represents an internationally accepted low limit that justifies the statement that a sector undergoes clustering. In each of these sectors there exist subregions where a certain spatial concentration may be detected, but these sectors are less agglomerated in space, and we can find only three sectors that demonstrate high spatial auto-correlation, however, this is often due to the "empty" adjacent areas.

Based on the survey, it can be concluded that the clustering of knowledge intensive service sectors cannot be proved in Hungary, so there are no substantially innovative clusters in these sectors. This is not surprising, since in moderately developed countries like Hungary the economy has not yet been driven by innovation.

The survey also demonstrated that Hungarian regions, counties and subregions are in very different phases of development and are linked to the global economy very differently. Consequently, their competitiveness can only be improved by very different strategies of economic development.

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Subregional Economic and Innovation Contribution of Hungarian Universities

Zoltán Bajmócy – Miklós Lukovics

Several success stories prove that universities are able to significantly influence regional development. Partially due to this fact a number of regions have created development strategies to strengthen the regional effects of universities and to motivate the academic sphere for a more intense involvement in regional economic development also in the post-socialist transition economies. In spite of this, it is not obvious whether the significant regional contribution of universities is a rule or rather an exception. On the top of this the validity of the relevant results of the literature can not be unambiguously extended to transition economies.

Present paper aims to measure the contribution of Hungarian higher education institutions to regional economic and innovation performance. On the one hand, it attempts to adapt the methodology of a former US study of Goldstein and Renault to a transition economy, and instead of regional to sub-regional (LAU-1) level. One the other hand it expands the focus of their method, and connects the role of universities to complex territorial innovation performance, and especially to knowledge exploitation ability. It concludes that universities have significant contribution to overall local innovation performance, but very limited contribution to the knowledge exploitation ability. This contribution is too forceless to result in the dynamic improvement of the local economic performance or in the rise of the local incomes.

Keywords: universities' regional contribution, innovation performance, transition economy, Hungary.

1. Introduction

The role of universities in systems of innovation and their contribution to economic development are widely approached research issues. The increasing importance of the academic sphere in the innovation systems is usually explained by the growing importance of knowledge compared to the conventional factors of production (Etzkowitz et al 2000).

Nowadays "the growth in technological knowledge relies increasingly on science" (Rosenberg 1994, p. 9.). This "ties industries to universities, which provide both people trained in the relevant fields, and research findings which enable the technology to advance further" (Nelson 1995, p. 77.). On the top of this, it is often argued that nowadays the conventional teaching and research functions of the

universities are able to evolve and generate economic effects only in synergy with the new function of the "economic utilization" (Etzkowitz et al 2000).

The contribution of universities to innovation performance and economic growth *may significantly differ* regarding the peculiarities of the given region or university. In certain cases the contribution of the academic sphere is apparent and vital. These success stories (Silicon valley, Route 128, Cambridge) served as a basis for numerous economic development actions all over the world (technology-transfer programmes, science parks, technology business incubators, etc.), but the success of these programmes are in may cases questioned (Cooke, 2001, Asheim–Coenen 2005, Löfsten–Lindelöf 2005).

Therefore, it remains a basic question whether universities' economic contribution is *a rule or rather an exception.* This seems to be particularly important in the post-socialist transition economies, where the success stories are absent, but still a number of central and local development strategies are based on the hoped economic development effects of universities.

In present paper we focus on the question whether universities' contribution to regional innovation and economic performance can be proved in a transition economy, namely in Hungary. In chapter 2 we synthesize the main finding of the literature dealing with the (regional) economic contribution of universities. We outline the importance of the regional-level analysis, and touch upon the peculiarities of transition economies in this respect. In chapter 3 we present the hypotheses to be tested. Chapter 4 provides an overview on the methodology of our analysis, which is based on Hungarian sub-regional (LAU-1) data. In chapter 5 we show the results of the analysis and we draw our conclusions in chapter 6.

2. Regional economic contribution of universities

In today's knowledge- or learning-based economy the innovation potential depends to a great extent on extra-organizational factors and relations, in other words the innovation system (Lundval 1992, Nelson 1993). In almost all innovation systems have higher education institutions (HEIs) a significant role, especially research universities as essential knowledge-producers (Inzelt 2004, Tödtling–Trippl 2005).

The literature of *innovation systems* has uncovered that not solely the presence of the universities are important, but the character and intensity of the relations between universities and other participants of the system. A large body of literature deals with the mechanisms through which the academic knowledge production affects the corporate innovation performance (Etzkowitz–Leydesdorff 2000, Inzelt 2004, Bercovitz–Feldman 2006), with the spatiality of these mechanisms (Feldman 1994, Morgan 2002, Goldstein–Renault 2004, Varga 2009) and with the transformation within the academic sphere that enables the operation of

these mechanisms (Etzkowitz et al 2000, Goldfarb–Henrekson 2003, Clarysse et al 2005, Antonelli 2008).

As we can see only a part of the studies dealing with the economic role of universities puts the problem of spatiality into the focus. One could easily argue that universities are rather national and not regional "resources". Students do not gain scholarships solely from the host region of the university, nor do they remain there necessarily after graduation. Furthermore research ties make universities become parts of global networks.

Nevertheless certain universities contribute significantly to their *local (regional)* environment and catalyze local economic processes. As a consequence regions are increasingly looking at universities as exploitable local "resources". This raises the need for analyzing the spatial characteristics of the university-business relations.

Although the external relations of the universities are to a great extent globally tied, a certain part of university-industry relations have local characteristics. This is due to the fact that the technology-transfer process is embedded into the contexts of local routines and local / regional systems of innovation (Bercovitz–Feldman 2006). Hence personal relations and local embeddedness gains and important role, which sheds light on the importance of the analysis of the local and regional innovation systems (Asheim–Coenen 2005). On the top of this, externalities (spillovers) that play a vital role in the innovation process have spatial characteristics, they are mostly local, thus the spatial distribution of the participants matters (whether they are spatially concentrated or evenly distributed) (Varga 2009). A number of innovation models emphasize that innovation is a spatial phenomenon, depending to a great extent on resources that are region-specific and can not be reproduced elsewhere (Ács et al 2000, Asheim–Gertler 2005, Storper 1997). Although the literature of territorial innovation models is heterogeneous (Moulaert–Sekia 2003, Lagendijk 2006), the given approaches usually emphasize the importance of the local scpecifities (participants and relations), the learning ability, which naturally sheds light on the essential role of knowledge-producing organizations.

Therefore the *spatiality of the effects of universities* has an abundant literature. The (spatially restricted) economic effects of the academic sphere are manifold: they range from the increase of local demand through the direct technological effects to the contribution of regional "milieu" (Goldstein–Renault 2004).

These potential effects can be divided into two main groups: the input-side or income effects, and the output-side or knowledge-effects, which latter covers the scientific, technical and economic knowledge streaming from the academic to the business sphere (Armstrong–Taylor 2000, Morgan 2002, Varga 2004). Income effects basically derive from the local spending of the university, its students and staff. Although they may have a significant role in certain areas, they are not able to

catalyze the local economy[1], they are static in nature. Conversely, knowledge-effects are able to induce dynamic local development: they can serve as a basis of the local innovation potential, and thus eventually the improvement of economic performance and the rise of local incomes.

In connection with the *knowledge-effects* the most intensely researched issue is probably the analysis of the local spillovers deriving from the spatial concentration of R&D activities. A number of empirical studies proved a significant and positive relation between university R&D and the number of company-owned patents[2] in case of spatial proximity (Audretsch–Feldman 1996, Anselin et al 1997, Varga 1998, Autant-Bernard 2001). With the increase of the distance the relation becomes insignificant. These econometric analyses, which are based on the knowledge-production function, provided important proofs of the existence of the academic knowledge spillovers and their local nature.

However, beside the knowledge externalities connected to the formalized R&D results, there are numerous other channels of universities' potential regional effects. Therefore it is still a pivotal question that, to what extent are the effects of universities general. Do they also affect (beside the patent or product-innovation effectiveness of the business sphere), the overall local economic performance or the rise of local incomes. In this respect the analysis of Goldstein and Renault (2004) based on American time series provides essential results. They generally proved that in the USA the presence of research universities significantly affects the rise of regional incomes, but only after 1986[3], when – as a consequence of the Bayh-Dole Act – universities started to make serious efforts to strengthen their industrial relations. They proved furthermore, that the channels of the R&D related effects are way broader than the transfer of formalized achievements (patents); overall university R&D expenditures are more significant indicators than the number of university patents.

While the econometric analyses based on the knowledge production function suggest that the critical concentration of R&D capacity and local industrial activities is required for the spillovers to become significant factors, Goldstein and Renault (2004) found that the general economic effects of universities are more intense in the smaller regions. It seems that universities are able to serve as a substitute for agglomeration economies to a certain extent.

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[1] The ways of strengthening the income effects are on the one hand the increase of the number of students and the staff, on the other hand the rise of the proportion of local spending. These face objective hinders (e.g. public procurement rules do not allow the university to prioritize local buying). Therefore the strengthening of the income effects is not an objective of local economic development.

[2] These studies usually use the number of patents as a measure of innovation performance, which can be seriously criticized. Nevertheless Ács et al (2002) proved that using the number of newly introduced high-tech products leads to the same results as using the number of patents.

[3] Although the Bay-Dole Act was adopted in 1980, its effects became measurable only a few years later.

However, the above *results can not be unambiguously exteriorized to transition economies*, it is not at all obvious, that these effects could be proved there as well. In the transition countries the performance of the regional innovation systems is weak (Hollanders 2006), so are the university-industry relations (Inzelt 2004, Papanek 2006), and the political actions aiming at the encouragement of university-related technology-transfer have just begun being amplified. Furthermore, the effectiveness of university-related local economic development programmes can be questioned in many cases (Barta 2002, Buzás 2003, Bajmócy 2006).

The literature of *Hungarian universities' economic contribution* is quite scarce. Inzelt (2004) provides a general overview on the transformation of university-industry relations, but spatiality is not in the focus of her inquiry. Varga (2009) verifies empirically that localized knowledge spillovers of university and private R&D are more intense in case of the spatial concentration of the system's participants. Several authors analyse the opportunities and effectiveness of university-related development-programmes (Barta 2002, Lengyel 2004, Pálmai 2004, Bajmócy 2006, Papanek–Perényi 2006), and the opportunities of university-based local economic development strategies (Lengyel 2009).

3. Hypotheses

The literature of universities' regional effects puts the knowledge-effects into the focus of the interest. In present paper we also carry on with this tradition, since we attempt to analyse the ability of Hungarian HEIs to boost the economy of their host region.

Studies that link the presence of universities to regional innovation performance use the number of patents or incidentally the number of newly introduced high-tech products as a measure of innovation. The general understanding of innovation (OECD 2005) is however much broader, and does not seem to be reducible to one given dimension.

On the basis of the Oslo Manual's recommendations a number of attempts have been made to measure the innovation performance of territorial units in its complexity – ultimately to map the performance of the innovation system (Arundel–Hollanders 2005, Hollanders 2006, Kanerva et al 2006, EIS 2007). Such a complex approach seems to be especially important in transition countries like Hungary, since in Hungary for example less than half of the innovative companies carry out any R&D activity (EIS 2007).

Therefore in present paper we attempt to link the presence of HEIs to the complex innovation performance of the territorial unit. Within this, the correspondence between HEIs and the region's knowledge-exploitation ability is especially important. On this basis we conceptualized our first hypothesis:

- *Hypothesis 1*: Higher education institutions contribute significantly and positively to sub-regional overall innovation performance, but they do not contribute to a substantive element of the innovation performance, namely the knowledge-exploitation capacity.

The literature surveyed in the previous chapter suggests that in the developed countries universities' economic contribution is more general than just affecting the innovation performance of the business sector. They contribute to the overall regional economic performance and the rise of local incomes as well. At the same time, the validity of such an effect in a transition country is not at all obvious:

- *Hypothesis 2*: Higher education institutions contribute significantly and positively to the growth of sub-regional economic performance and the income of the residents.

4. Methodology

For the purpose of our study we took the analysis of Goldstein and Renault (2004) as a starting point, but we carried out certain modifications on it. These modifications basically derive from three factors. First, we widened the focus of analysis; beside the change in average wages we also examined the effects of HEIs on the complex innovation performance with a special emphasis on the knowledge-exploitation capacity, and the change in the sub-regional economic performance. Second, we carried out our analysis on local (LAU-1) level, which significantly influenced data availability. Therefore we had to make certain changed on the set of indicators used. Third, we carried out our examinations in such a country, where the sub-region of the capital (Budapest) concentrates a significant proportion of the population, gross value added (GVA), and research capacities, and excels from the country also in a relative way. This inevitably had to be considered in the statistical analysis.

The units of our analysis were the 168 Hungarian (LAU-1) sub-regions, the examined period was 1998-2004. The system of statistical sub-regions undergone slight changes between the two dates, therefore we converted all the data to be in line with the 2004 system[4]. For the computations we used MS Excel and SPSS 15.0.

4.1. Indicators used

For analyzing the regional effects of HEIs, we used three set of indicators: the dependent variables (which indicate the potential forms of contribution), HEI-related

[4] The data therefore refer to the 168 sub-regions defined by the Government Regulation 244/2003.

indicators, and control variables. During the selection of the variables we carried out certain modifications on the set of indicators used by Goldstein and Renault (2004). These changes were partially due to the differences in the focus of examination, and partially due to the restricted sub-regional data availability (Table 1).

Table 1. Indicators of the analysis

Dependent	Change in the gross personal tax base per tax payer compared to national average (in % points)
	Change in the gross value added per capita compared to national average (in % points)
	Sub-regional Summary Innovation Index (SRSI)
	Knowledge Exploitation Index (KEI)
HEI-related	Is there a HEI in the sub-region
	Is there a state HEI in the sub-region
	Is there a university in the sub-region
	Is there a college in the sub-region
	Number of teaching staff in HEIs per 1000 inhabitants
	Number of scientists with PhD per 10000 inhabitants
	Number of full-time students in HEIs per 1000 inhabitants
	Numbers of degrees awarded in the fields of science, engineering and informatics
Control	Number of employees
	Population of the centre of the sub-region
	Per cent employment in manufacturing and construction
	Per cent employment in services
	Complex accessibility indicator
	Per cent of incomes generated by proprietorships
	Number of patents per 10000 inhabitants
	Per cent of incomes generated by proprietorships
	Number of patents per 10000 inhabitants
	Base-year level of gross personal tax-base per tax payer
	Base-year level of gross value added per capita
	Trade integration (Export sales per gross value added)

Source: own construction

Two of the *dependent variables* are related to the innovation performance: the sub-regional summary innovation index (SRSI), and the knowledge-exploitation index (KEI)[5]. These measures of innovation potential refer to adaptability and the speed of technical change. These capabilities can eventually lead to the change in the other two dependent variables.

The latter two dependent variables refer to the change in the sub-regional economic performance and in the incomes of the inhabitants: the per capita gross value added (GVA) and the gross tax base per tax payer. Per capita GVA is analogous to per capita GDP in its content[6], while the gross tax base per tax payer

[5] The computing method of the two indexes is outlined later in the chapter.
[6] GDP is not available for LAU-1 sub-regions, thus GVA is used as a substitute.

captures the disposable incomes of the residents[7]. The computation of the variables is analogous to the method of Goldstein and Renault (2004). We first calculated the values of the variables as a percentage of the national average for each sub-region for 1998 and 2004. The dependent variable is then calculated as a difference in the indexes for the gives sub-region between the two years. The positive value of the variable therefore refers to a growth rate exceeding the national average (catching-up, or increasing the advantage).

Thus two of our dependent variables are based on the change of the indicator values, while two are cross-section data. But innovation performance refers to the speed of change in itself, so the introduction of the growth rate of the innovation indexes is unneeded.

The presence and the performance of HEIs is measured by eight indicators. Four of them are dummy variables (present or not in the sub-region), while for are measured on scale. These latter are indicators related to the basic functions of the universities: the number of teaching staff, the number of full-time students, the number of scientists with PhD, and the number of degrees awarded in the fields of science, engineering and informatics. These variables – where available – refer to the base year (1998).

To capture the potential effects of universities the use of university-related indicators is not sufficient, since the difference between sub-regions with and without HEIs may be caused by many other influencing factors. Therefore in our analysis we applied control variables which are potentially able to explain a significant proportion of the dependent variable's variation.

The first group of the *control variables* tries to capture the agglomeration economies, they refer to the size of the sub-region. Instead of using the overall population of the sub-region, we decided to introduce the population of the centre of the sub-region, which better indicates the size of the local concentration.

In order to map the economic structure of the sub-regions we used two variables: the relative weight of manufacturing and services in the employment. We indicated the accessibility of the sub-region by the complex accessibility index[8] of the Hungarian Central Statistics Office (KSH 2004). Several empirical results prove the link between entrepreneurship and economic performance (Bosma–Harding 2006). We used two variables in this category: the per cent of incomes generated by sole proprietors and the number of patents per 10000 inhabitants.

[7] Goldstein and Renault (2004) used the wages as dependent variable, but in this case we also had to face the unavailability of the data in sub-regional level.

[8] The index considers the time distance from the nearest county-centre (40%), from the nearest sub-region-centre (40%), and the state of supply (20%), which latter indicates the extent to which the residents are dependent on the services of the centres. Accessibility is calculated for all the municipalities and then, weighted by the population of the municipalities, the sub-regional index is calculated.

We considered furthermore the base-year performance of the sub-region to control the endowment effect. On the top of these we introduced a variable reflecting the peculiarities of the transition countries: the indicator of trade integration (export sales per GVA). A number of empirical results indicate that in Hungary foreign direct investments, and in association with this export orientation basically influences territorial disparities (Lengyel–Lukovics 2006, Kovács–Lukovics 2006).

4.2. The steps of the analysis

We carried out the analysis of HEIs' potential contribution in two basic steps. The differences regarding the innovation and economic performance of subregions with and without HEIs may derive from many factors. In the *first step* of our analysis we attempted to explain these potential differences by using our control variables.

We fitted linear regression models to all of the four dependent variables in order to test the explanatory power of the control variables. We used the "backward" method of the SPSS so we gained such "base-models" where a relevant set of the control variables are included with the maximum possible overall explanatory power. Therefore the "base-models" indicate the explanatory power of the relevant control variables in case of all the dependent variables.

In the second step we attempted to unfold the extent of university contribution. We used here two methods. First, we analysed whether there is a correspondence between the dependent variables and the HEI-related indicators when controlling for the effects of the relevant set of control variables. We calculated here partial correlations controlled for the independent variables of the base models.

Second, if we found significant correlation between a HEI-related indicator and a dependent variable, than we attempted to supplement our base-model with that given variable. Actually, we analyzed whether the HEI-related indicators provide extra explanatory power to our models.

We must mention here that both the HEI-related indicators and the control variables are strongly correlated to each-other, thus our regression models are characterized by strong multicollinearity. Hence we only analyzed the overall explanatory power of the models (where the lack of multicollinearity is not a precondition), we could not and did not draw any conclusions on the partial effects of the given variables.

4.3. The distorting effects of the Budapest sub-region

We inevitably had to consider during the analysis that a significant proportion of Hungary's population, economic performance and research capacity is concentrated in the sub-region of the capital (Budapest). The values of the Budapest sub-regions

significantly influence the average values of the dependent variables and thus distort the results of our examinations.

Therefore we removed the values of the Budapest sub-region from the database in order to gain a more realistic picture on the remaining part of the country. Thus all our results refer to Hungary's extra-Budapest parts. We certainly removed the values of Budapest also when calculating the average values of the given indicators.

4.4. Measuring the complex innovation performance of the sub-regions[9]

One of the main focuses of our study is to unfold the correspondence between the presence of HEIs and the innovation performance of the host sub-region. Innovation performance data on the Hungarian sub-regions were not available, thus we had to carry out our own analysis to construct these data.

The first step of the innovation analysis was the selection and classification of the indicator set. In connection with the construction of the groups we built on Tödtling and Trippl's (2005) approach on the structure of regional innovation systems, the smart infrastructure concept of Smilor and Wakelin (quoted by Stimson et al 2006), which has became widely known through the interpretation of Malecki (1997), and the arguments of Florida (2002) on the economic geography of talent. We attempted to define our sub-indexes in such a way that they should reflect to the elements of a "typical" regional innovation system.

In purpose of the index selection the indicators of the Summary Innovation Index of the European Innovation Scoreboard (EIS 2007), the Service Sector Innovation Index of the European Trend Chart on Innovation (Kanerva et al 2006), the EXIS Summary Index (Arundel–Hollanders 2005), the National Innovative Capacity Index of Porter and Stern (2003), the Europe Creativity Index of Florida and Tingali (2004), the RRSI Index of the European Regional Innovation Scoreboard (Hollanders 2006), the indicators of the analysis of Csizmadia and Rechnitzer (2005) on the innovation potential of Hungarian cities and of Kocziszky (2004) on the innovation potential of the sub-regions of the North-Hungarian Region served as a basis.

We tried to avoid to reduce the innovation output to one certain (and perhaps ill-defined) indicator. However this approach would provide the advantage of an objective selection criteria[10], the choosing of the dependent variable is problematic, and it would not provide a detailed picture about the innovation system's performance. Besides, the sub-regional availability of data influenced the construction of the indicator-set.

[9] A more detailed description of the innovation performance measuring method, and the results of an analysis that also includes data on the Budapest subregion can be read at Bajmócy–Szakálné (2009).

[10] Like in the analysis of Porter and Stern (2003), where the relevance of the indicators were defined by their explanatory power in a regression model where the number of USPTO applications served as the dependent variable.

Eventually we carried out the innovation performance analysis with 28 indicators (Table 2), which were classed into three groups: knowledge production (10 indicators), knowledge exploitation (9 indicators), and smart infrastructure (9 indicators). Three sub-indexes measure the performance in these three categories, while the sub-indexes serve as the basis of the Sub-regional Summary Innovation Index (SRSI) with an equal weight. The indicators of the Knowledge Production Index measure the ability to create new scientific and technological knowledge. The indicators of the Knowledge Exploitation Index (KEI) attempt to measure the characteristics of the innovative business sectors, while the Smart Infrastructure Index systematizes the factors that provide a background for sustaining knowledge production and exploitation.

Table 2. The indicator set of the innovation performance analysis

Knowledge creation	1	Number of R&D performing units per 100000 inhabitants
	2	Total staff of R&D units per 1000 inhabitants
	3	Calculated staff number (FTE) of R&D units
	4	Calculated staff number of R&D units per 1000 inhabitants
	5	Number of scientists with PhD per 10000 inhabitants
	6	Investments of R&D units per 1000 inhabitants
	7	R&D costs per 1000 inhabitants
	8	Expenditures of R&D places
	9	Expenditures of R&D places per 1000 inhabitants
	10	Number of patents per 10000 inhabitants
Knowledge exploitation	1	Export sales as a percent of total sales
	2	Export sales per inhabitant
	3	Number of foreign owned companies per 1000 inhabitants
	4	Share capital of foreign owned companies as a % of total share capital
	5	Incomes from intellectual properties per inhabitant
	6	Percent of companies in NACE 24 and 29-34 divisions within all companies (high and medium tech manufacturing)
	7	Percent of companies in NACE 64 and 72-73 divisions within all companies (high-tech services)
	8	Percent of companies in NACE 74 division within all companies (business services)
	9	Number of knowledge-intensive firms with more than 50 employees
"Smart" infrastructure	1	Per cent of employees with university or college degree
	2	Percent of white collar workers in leading positions within all employees
	3	Number of full-time students in higher education institutions per 1000 inhabitants
	4	Number of teaching staff of higher education institutions per 1000 inhabitants
	5	Number of ISDN lines per 1000 inhabitants
	6	Registered members of public libraries per 1000 inhabitants
	7	Cinema visits per 1000 inhabitants
	8	Museum visitors per 1000 inhabitants
	9	Tourist arrivals in public accommodation establishments per 1000 inhabitants

Source: own construction

In the second step of the innovation performance analysis we compared the innovation performance of the sub-regions with respect to the SRSI and the KEI. For the calculation of the index values we built on the methodology of the European Innovation Scoreboard's Summary Innovation Index and Service Sector Innovation Index. On this basis the construction of our Sub-regional Summary Innovation Index is as follows:

1. *Calculating the minimum and maximum values for each indicator*. Regarding almost all of the 28 indicators, the values of some sub-regions significantly excelled the national average (usually positively). We considered a value to be an outlier if its distance from the national average exceeded the standard deviation more than four times. In most of the cases 1-3 values had to be considered as outliers. We removed the outliers when calculated the minimum and maximum values in order to avoid the extreme concentration of the index values. We also removed the values of the Budapest sub-region.
2. *Rescaling of the values*. We subtracted the indicator's minimum from each subregional value and divided by the difference of the maximum and minimum value. In this way all the rescaled values are between 0 and 1. Outlier received 0 or 1 depending on the direction of deviation.
3. *Calculating the sub-indexes*. The sub-indexes are calculated as the arithmetical mean of the rescaled values of the indicators in their group. We faced a dilemma about the occasional weighting of the indicators, but – just like in the case of the EIS – we rather put emphasis on the transparency of the method. In addition the development of an objective weighting system would have raised further questions.
4. *Calculating the SRSI*. The SRSI is calculated as the unweighted arithmetical mean of the three sub-indexes. The SRSI and the sub-index values are measured on scale therefore they are capable of being used for the comparison of the sub-regions. The distance of sub-regional innovation performance from the national average can also be interpreted in this way.

Out of the results of our innovation performance analysis *we utilized the SRSI and the KEI values*. The other two sub-index values are heavily influenced by indicators that can directly or indirectly be linked to the presence of HEIs, therefore we could not use them in our study. SRSI is also influenced by these indicators, even though we decided to use this index as a dependent variable. In this case the overall influence of HEI-related indicators are presumably much more modest, the effects of other indicators may overcompensate it. Nevertheless these results have restricted power.

For the calculation of the KEI we did not use any HEI-related indicators, so in this case we do not have to face such problem. The analysis of knowledge exploitation ability has basic importance in our examinations, since it may be able to transform the university outputs into increased economic performance.

5. Results

While presenting the results we follow the steps of analysis outlined in the methodological chapter 4.2. During the given steps we first show the results regarding the dependent variables SRSI and KEI, and than regarding the further two dependent variables. This is in line with the logic of universities' knowledge-effects, since innovation capacity (and especially the knowledge exploitation ability) can lead to the increased economic performance and incomes.

By comparing the performance of subregions with HEI (let us call them *study population*), and subregions without HEI (*control group*) we gained an overview on HEIs' effects on the dependent variables. The differences between the two groups are spectacular.

The SRSI and the KEI value of the study population (0,36 and 0,35) is significantly higher than in the case of the control group (0,13 and 0,18). With respect to the other two dependent variables the case seems to be more complex. Regarding the per capita GVA the study population departs from a significantly better position (well above the national average), which may be due to the size or partially the static income effects of HEIs. But the advantageous initial position did not infer a more intense growth rate. In fact the differences between the two groups decreased[11].

The case is quite similar regarding the change in "tax base per tax payer", however the differences are not too sharp this time[12]. The apparently higher base-year performance may partially explain the lower growth rates in itself, but only partially, since in Hungary the territorial disparities measured at both regional and subregional level widen (Lukovics 2008). Therefore the higher base-year values do not necessarily infer the lower growth rates.

Therefore spectacular differences appeared between the study population and the control group. However the direction of the deviation was surprisingly opposite regarding the innovation and the economic performance. Still, these differences cannot be unambiguously accredited to the presence of HEIs at this level of analysis, since they may derive from many other factors.

5.1. Explanatory power of the control variables

We attempted to reveal the causes of the differences between the study population and the control group by introducing control variables. First, we had to test the explanatory power of the used control variables. We fitted linear regression models

[11] Change in per capita GVA compared to the national average in percentage points is -7,68 in case of the study population and 3,81 in case of the control group.

[12] Change in gross tax base per tax payer compared to the national average in percentage point is -0,39 in case of the study population and 0,33 in case of the control group.

on all our dependent variables, where a relevant set of the control variables were used as independent variables[13] (Table 3).

Table 3. The explanatory power of the control variables

			SRSI	KEI	GVA	Tax base
Control variables		Number of employees		x	x	x
		Population of the centre of the sub-region	x	x	x	x
		Per cent employment in manufacturing and construction				x
		Per cent employment in services	x			x
		Trade integration	x	x	x	
		Complex accessibility indicator		x		x
		Per cent of incomes generated by proprietorships	x			x
		Number of patents per 10000 inhabitants	x	x	x	x
		Base-year level of Gross personal tax-base per tax payer	x	x		x
		Base-year level of Gross Value Added per capita			x	
Model	**Summary**	R	0,916	0,916	0,551	0,611
		R Square	0,839	0,840	0,304	0,373
		Adjusted R Square	0,832	0,834	0,282	0,342
		Std. Error of the Estimate	0,051	0,053	48,935	3,720
		Durbin-Watson	2,156	2,041	2,009	2,253
	ANOVA	Sum of Squares	2,159	2,388	168066,069	1302,942
		df	6	6	5	8
		Mean Square	0,360	0,398	33613,214	162,868
		F	138,462	139,885	14,037	11,766
		Sig.	0,000	0,000	0,000	0,000

Note: "x" means that the given control variable has been put into the "base model". We did not mark the Beta and t values of the given indicators, nor did we analyse their partial effects due to the strong multicollinearity of the models.
Source: own calculations

The explanatory power of the control variables are high regarding SRSI and KEI, while relatively low in case of per capita GVA and gross tax base per tax payer. This step of the analysis revealed which group of the control variables explains the variance of the given dependent variables the best, and how strong this

[13] The provided the detailed description of the method in *chapter 4.2.*

explanatory power is. We did not analyse the partial effects of the given indicators due to the strong multicollinearity of the models, but for the purpose of our study is was not necessary anyway. In the next step we attempt to control for the effects of these relevant control variables, and try to increase the explanatory power of these "base-models" by introducing the HEI-related variables.

5.2. Regional economic effects of the Hungarian HEIs

On the basis of the results of the previous step we here attempted to reveal the real effects of the HEIs. First, we analyzed the correspondence between our eight HEI-related variables and the dependent variables while we controlled for the effects of the relevant control variables. We calculated partial correlations while controlling for the effects of the independent variables of the "base-models" (presented in Table 3) – in other words the relevant set of control variables. These partial correlation results showed great differences with respect to the different dependent variables (Table 4).

Regarding the SRSI all the HEI-related variables proved to be significantly correlated while filtering the effects of the control variables. The partial correlation values are relatively strong and in all cases positive. Regarding the KEI only one partial correlation result proved to be significant (the number of degrees awarded in the fields of science, engineering and informatics), but the strength of the correlation is weak in this case. Regarding per capita GVA and gross tax base per tax payers non of the HEI-related indicators correlated.

Table 4. Partial correlation results

	SRSI		KEI		GVA		Tax base	
	Pear-son's	Sig	Pear-son's	Sig	Pear-son's	Sig	Pear-son's	Sig
Number of teaching staff in HEIs per 1000 inhabitants	**0,714**	0,000	0,101	0,202	0,680	0,389	0,100	0,210
Number of full-time students in HEIs per 1000 inhabitants	**0,678**	0,000	0,057	0,476	0,114	0,149	0,054	0,501
Number of scientists with PhD per 10000 inhabitants	**0,663**	0,000	0,068	0,390	-0,170	0,830	0,080	0,315
Is there a HEI in the sub-region	**0,391**	0,000	0,056	0,484	0,340	0,664	0,134	0,092
Is there a state HEI in the sub-region	**0,455**	0,000	-0,044	0,580	0,820	0,298	-0,040	0,618
Is there a university in the sub-region	**0,528**	0,000	0,034	0,672	-0,300	0,707	0,045	0,570
Is there a college in the sub-region	**0,363**	0,000	0,095	0,230	0,610	0,442	0,158	0,046
Number of degrees awarded in the fields of science, engineering and informatics	**0,606**	0,000	**0,133**	0,092	0,100	0,899	0,132	0,097

Source: own calculations

On the basis of these results we attempted to increase the explanatory power of the base-models by entering the relevant HEI-related indicators. In case of the KEI the only HEI-related indicator that showed significant partial correlation did not increase the explanatory power of the model. In connection with the SRSI we managed to further increase the high explanatory power of the base model (Table 5). We constructed here two models. In model 1 we used the backward method of the SPSS, and in this way four HEI-related indicators remained in the model. In model 2 we entered all the eight HEI related indicators and the control variables of the base-model. The explanatory power of both two models is very strong.

Table 5. The explanatory power of HEI-related indicators regarding SRSI

		Base model	Model 1*	Model 2*
Model summary	R	0,916	0,961	0,969
	R Square	0,839	0,924	0,939
	Adjusted R Square	0,832	0,920	0,934
	Std. Error of the Estimate	0,051	0,035	0,032
	Durbin-Watson	2,156	1,821	1,905
ANOVA	Sum of Squares	2,159	2,380	2,418
	df	6	9	14
	Mean Square	0,360	0,264	0,173
	F	138,462	212,4	167,8
	Sig.	0,000	0,000	0,000

Note: * Backward method. Dependent variable: SRSI. Independent variables: (1) Population of the centre of the sub-region (2) Per cent employment in services (3) Trade integration (4) Number of patents per 10000 inhabitants (5) Base-year level of GVA per capita (6) Is there a HEI in the sub-region (7) Number of teaching staff in HEIs per 1000 inhabitants (8) Number of full-time students in HEIs per 1000 inhabitants (9) Number of scientists with PhD per 10000 inhabitants. ** Enter method. Dependent variable: SRSI. Independent variables: the control variables of the "base model" and all the HEI-related indicators.
Source: own calculations

The results of our analysis indicate the very restricted economic effects of HEIs in the Hungarian sub-regions (not counting with the Budapest sub-region). Although the presence of HEIs influences the overall innovation performance of the host sub-region (which result has a limited power due to the set of indicators used[14]), the contribution to the knowledge exploitation ability can not be proved. Differences between the study population and the control group in this field can be well explained by the control variables. The introduction of HEI-related indicators does not provide extra explanatory power. Therefore *we accept our first hypothesis*.

Our results unambiguously show that the presence of HEIs does not affect the growth rate of per capita GVA (economic performance) and gross tax base per tax payer (incomes of the inhabitants). However these results leave the opportunity for the presence of income-effects open. Since the absolute values of the study population are significantly higher with respect to both two variables, the presence of income-effects is quite probable. At the same time these effects are static, do not influence the growth rates. Therefore we *do not accept our second hypothesis*, the presence of HEIs does not affect the growth of sub-regional economic performance and incomes in Hungary.

[14] We mentioned this in chapter 4.4.

6. Conclusions

In present paper we studied the link between the presence of higher education institutions and the innovation and economic performance of their host region in a transition country, Hungary. On contrary to developed countries, the local knowledge-effects of universities are not significant in Hungary (outside of Budapest), nor are the effects on the economic performance of the host region, and on the rise of local incomes.

By linking the presence of universities to the complex sub-regional innovation performance we found that the knowledge-producing ability did not result in increased knowledge-exploitation ability. In Hungary the university-based local economic development programmes are therefore carried out in such an environment, where the knowledge-producing and knowledge-exploiting abilities are spatially departed. Hence the success of these programmes depends to a great extent on the endogenous development of industries that build on the local knowledge-producing capacity. Such a process is inevitably slow and ambiguous.

We showed that the differences between sub-regions with and without HEIs do not derive from the presence of universities, they can be well explained by other factors. HEIs contribution is restricted to the optional presence of the income-effects, they are not able to boost the local economic performance or the disposable incomes of the residents.

In Hungary, in the studied period HEIs can not be considered as real „resources" of local development. Regional innovation systems are not able to link the knowledge-producing ability to knowledge-exploitation, thus the effects of universities may make themselves felt only in the national innovation system. But this inevitably infers the lower intensity of the effects, since several channels of university-industry relations require spatial proximity.

Our results suggest that the nature and intensity of higher education institutions' regional economic and innovation contribution differ in developed and transition economies. This infers a strong need for further empirical evidences from transition countries, and calls for a cautious adaptation of university-based development tool that proved to be successful in highly developed regions.

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Role of Proximity in Regional Clusters: Evidence from the Software Industry

Zsófia Vas

In 1990s, the appearance of information and communicational technologies weakened the importance of geographical distance and changed the economic role of proximity, defined as small distance. Geographical proximity plays a crucial role in information and knowledge transfer and in improving the innovative capacity of firms. However, business partners may have successful cooperation in spite of great geographical distances too, due their relational proximity, by using the infocommunication technologies too.

Benefiting from the advantages of geographical and relational proximity, clusters form in less developed regions too. Present paper attempts to explore the special characteristics of cluster formations in the software industry in the 'knowledge isle' of the less developed Southern Great Plain Region, in Szeged subregion. To map the relevance of the e geographical concentration and the industrial base of a potential software industry in Szeged subregion, it is substantial to count location quotient of employees and enterprises. With the purpose of surveying the fields of cooperation and the strength of relational proximity between software enterprises, a questionnaire is made.

Keywords: geographical and relational proximity, cluster, software industry, Szeged subregion

1. Introduction

Today, clusters are one of the most competitive instruments ensuring the future development of the knowledge-based economy, which stimulate a concentration of expertise and knowledge, acting as 'hubs of innovation'. Regional clusters are local systems of production, where companies and institutions in a particular industry create an innovative system of business and non-business relations in a limited geographical area (Porter 1990, 2000). Yet the competitive advantage of clusters rests not only on spatial concentration.

Clusters are considered to be the basis of local, regional and even national politics in many countries. They are the new poles of competitiveness forming the economic map of the world, enhancing the development of the global economy (OECD 2001). The European Union highly supports their formation and growth, and the European Cluster Observatory manages their mapping, providing a wide variety of data on them for all the countries and regions in the EU.

The appearance of modern information and communication technologies (internet, mobile phone etc.) meant the shaping of new channels of information and knowledge transfer, and revealed that business partners might have knowledge-based cooperation with each other in spite of great geographical distances too, due to their common knowledge base, behavior pattern, cultural background etc. The characteristics of 'being close to each other' have changed, the importance of relational proximity increased. In connection with the formation of knowledge-based relations, the examination of different proximity dimensions, beside the geographical one, the 'relational space' and 'networks' also came to the front. The literature of regional science also started to focus on the changed role of the proximity; the concept of proximity has already been examined by many writers and institutions (Kirat–Lung 1999, Boschma 2005).

The phenomenon of the formation of the double meaning of proximity draws attention to create new approaches to examine clusters and the advantages deriving from geographical (physical) and relational (Lagendijk–Lorentzen 2007), in other words used by the French School of Proximity Dynamics, organized proximity too (Kirat–Lung 1999, Torre–Rallet 2005).

Information technology (IT) plays an important role in the development of knowledge-based economy, its role is emphasized in strategic development programs of the European Union. Software industry (as a part of the IT sector), has become an international leading branch, which contributes to the development of information society. It is highlighted to explore the conditions of the development of software cluster, based on the dimensions of proximity. Clusters appear as successful economic development tools in less developed countries in the European Union.

The role of proximity has been changed in the information technology related clusters in Hungary too, although it has yet not been measured. It became reasonable to examine whether cluster formation may occur or not it in the less developed Southern Great Plain Region (NUTS level 2) and in its 'knowledge island', in the city of Szeged and in its subregion. To explore the chances in Szeged, it is worthy to see the example of foreign clusters operating in the field of information technology in other less developed regions, and to adopt the best practices experienced there. The basic question to answer is that does the software industry have the opportunity for strengthening and clustering in a less developed region? What kind of effects of proximity can be observed in the knowledge-based software industry in Szeged subregion?

With a view to demonstrate the future opportunities for clustering in the software industry in the Szeged, the first step is to examine the advantages of geographical concentration of software companies and related institutions in Szeged subregion, by counting location quotient, afterwards to identify the presence and strength of relational proximity to which interconnection can be traced back, by making a questionnaire with the entrepreneur circle of the software industry.

2. Economic role of proximity

In the last decades, the process of globalization shed light on the formation of a new spatial organization of the economy (Lengyel–Rechnitzer 2004). The intensity of global competition revealed the increasing importance of geographical concentration, the co-localization of business actors, ensuring permanent competitive advantages for them.

Proximity is a critical criterion in firms' choice of where to locate its productive units. Location and geographic concentration have become key factors in the diffusion and exploitation of knowledge, especially in the context of innovation, cluster development and knowledge spillover. Proximity reduces uncertainty, solves the problem of coordination, facilitates the interactive learning and thus has a positive impact on the economic performance and growth of a region (Krugman 2000). Most regional, national development programs on regional growth emphasize factors like the nearness of high-tech firms and universities, the proximity of experts and researchers or similar sectors.

Taking a closer look at the notion of proximity in theoretical and empirical approaches, we find that its concept used in many way: we may talk about geographical, cultural, organizational, technological, cognitive and even institutional proximity etc. (Torre–Rallet 2005, Knoben–Oerlemans 2006, Lengyel 2008). All these dimensions are certainly not identical, but refer to 'being close to something' measured on a certain dimension (Knoben–Oerlemans 2006). As Ann Markusen (1999) described, proximity is a 'fuzzy concept'. In many cases companies in proximity, not in the geographical sense, can have successful cooperation due to their common language, common skills, and experiences, social and institutional background.

This is also facilitated by the use of information technology. Twenty five years ago the only way to work with someone at another institution was to talk with them by wired phone or visit in person. But phone calls and travel were expensive in a big distance. The appearance of infocommunication technologies, like internet in the 1990's explicitly changed the value and the necessity of geographical and other dimensions of proximity, and it became much cheaper to collaborate. As the example of Bangalore shows, software companies in India can develop software products and carry out the order of software companies in the USA, due to not to their geographical, but relational proximity.

Literature (Torre–Gilly 2000, Capello–Faggian 2005, Torre–Rallet 2005) usually defines two main types of proximity: geographical and organized proximity. When the proximity concept is used, what is often actually meant is *geographical proximity*, which is signified as spatial, local or physical (Knoben–Oerlemans 2006). Geographical or regional sciences traditionally use the notion of proximity, defined as short geographical distance. Distance basically means shortest way between two points, and refers to 'spatial non-identity', - not being in the same place

(Nemes Nagy 2009) and measures the amount of physical space between two units (individuals, organizations, towns etc.). Short distance brings the individuals together, favours information transfer and facilitates the exchange of knowledge, especially tacit knowledge. Agents in geographical proximity, benefit from positive externalities (Lengyel–Mozsár 2002). The positive effects may appear in the reductions of transfer and transaction costs, in the number of inputs at lower prices (Lengyel 2001). The diffusion of knowledge generates positive externalities, and knowledge flow increases the productivity of activities of research and development (R&D). Empirical studies prove that firms near knowledge (tacit and even in case of codified knowledge) sources can have better innovative performance than firms located elsewhere (Boschma 2005).

For today, it has become clear that it is wrong to associate proximity only with its geographical meaning. *Organized proximity*, which is not geographical but relational, is defined as the ability of an organization to make its members interact. The organization facilitates the interactions within itself between employees and with other entities outside the organization. Organized proximity is built on two types of logic. Firstly, when two members of one organization interact, they are in proximity, because their interaction is facilitated by (common, explicit or implicit) rules, routines and behavior that they use and follow. This is the *logic of belonging* of the organized proximity, which develops cooperation between researchers and engineers in the same firm (Torre–Rallet 2005). Secondly, organized proximity reflects the *logic of similarity*. Two individuals are close to each other, because they are 'alike", they speak the same special language; they share a system of common interests, beliefs and knowledge in the same cultural sphere.

The researchers of the "Dynamics of Proximity" group uses the notion of relational proximity (instead of organized proximity) that includes the spatial dimension of relations. The most frequently examined dimensions in addition to geographical ones, - as the critical assessment of Boschma (2005) underlines, - are the cognitive, organizational, institutional and social proximity. These four categories together are based on the notion of organized proximity.

- The concept of *cognitive proximity* that has been developed by Nooteboom (2006) is generally defined in terms of common knowledge base and expertise among agents. Actors in cognitive proximity have similar knowledge base, thus they transfer knowledge and communicate with each other more effectively.
- The notion of *organizational proximity* means relations in the same space either within or between organizations, and refers to the similarity between individuals sharing the same reference space and knowledge (Boschma 2005). Organizational arrangements are mechanism that coordinate transactions and enable the transfer of information and knowledge.
- Actors are in *institutional proximity*, because they pertain to one institutional framework at macro-level. Relations and interactions between actors and

group of actors are regulated by a set of rules and laws (formal institutional framework) and common habits, routines, (business) practices (informal institutional framework) (Boschma 2005).

- *Social proximity* can be defined in terms of relationship between actors at the micro level embedded in the same social context. Actors share trust based on friendship, kinship and experience (Boschma 2005). If business relations (within an organization) are more socially embedded, the possibility of a better innovative performance is available.

The dimensions of proximity are strongly linked to each other. Even if they operate through different mechanisms, all types increase the effectiveness of learning, have a positive effect on the production of knowledge-based externalities, and facilitates networking and clustering (Albino et al 2007). Firms in cognitive or organizational proximity might be able to communicate without face-to-face interaction using modern communication technologies, overcoming the problems caused by large geographical distance (Knoben–Oerlemans 2006) Taking the new role of information and communication technologies into account, we can state that neither is geographic proximity necessary per se, nor might it not be sufficient in interactions and cooperation. That is reason why literature differentiates permanent and temporary geographical proximity (Gallaud–Torre 2004).

3. Regional clusters in terms of proximity

The concept of proximity provides a framework for analyzing the different spatial organizations, like clusters. Clusters exist, their numbers are increasing and more and more policies are implemented to promote their development, and there are many reasons that describe their success. It became clear that geographical proximity is necessary in innovation and research activities, and facilitates the flow of information and knowledge between actors. Michael Porter (2000) emphasizes the fundamental role of geographical concentration in case of clusters and defines regional cluster as '*geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities'*.

Enterprises have several advantages of acting within a cluster. The proximity of the companies leads to the inflow of skilled people from other regions and sectors. Therefore, the cluster members have better access to employees and suppliers. The cooperation of neighbouring companies can lead to the use of common services and realization of joint projects, processes. In the cluster, the availability of information (formal or informal) and technology (infrastructure, IT services) is generally higher. The main advantage of cluster is the increased level of innovation by using the

informal and formal networking and the pool of resources for research and development.

The existence of clusters rests not only on geographical proximity, but also on several other factors. The economic relations shaped between cluster participants are embedded in the social network and the latter often have strong territorial roots. Synergy between interconnected partners does not form, if they are not in social proximity. Also cooperation may occur between actors from different organizations, but it happens due to the same university origins or social and family network. Social proximity reduces the uncertainty, just like cognitive proximity. This is true in case of cluster members and especially in case of newly entering companies, when they search for new knowledge. As a rule, firms' aim is to find partners in proximity of their own knowledge base. Another important factor is, that geographical context of economic interactions is largely conditioned by the role of institutions.

Cluster members are not only located in the same area, but they form a strong system of innovative relations, and cooperate with each other in their own interest to exchange information and technology, and to transfer knowledge etc.

Lagendijk and Lorentzen (2007) based on the categorization of Torre and Rallet (2005) defined all the combination of geographical and relational (in their own words organized) proximity (Table 1). In terms of proximity, clusters can be described as the intersection of strong geographical and strong organized proximity. For example if organized proximity is strong, but geographical proximity is weak, it characterizes non-localized interactions, like value chain. The geographical and organized proximity are equally more imperceptible in rural, less developed regions, and the agglomeration is an example where the strong geographical proximity is a basic factor, the organized proximity is not.

Table 1. Intersection between geographical and relational proximity

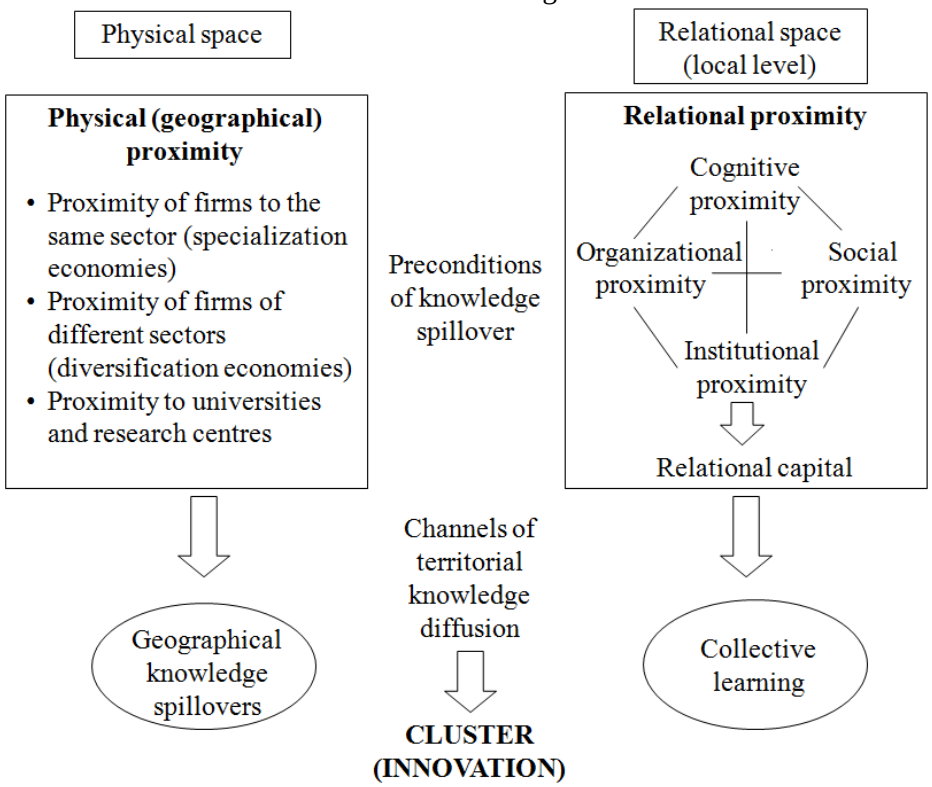
Geographical proximity	**Relational proximity**	
	Strong	Weak
Strong (close)	(1a) Local system of innovation, (milieu) production (*cluster*) (1b) Temporary (face-to-face) co-localization (projects, meetings)	(3) Co-location without interaction or coordination, activities in spatially integrated areas (agglomeration)
Weak (at a distance)	(2) Non localized interaction (e.g.trans-local organizations, value chains, coordination using ICT)	(4) Activities in isolation (e.g. in rural peripheral areas)

Source: own construction on the basis of Lagendijk and Lorentzen (2007)

As noted above, knowledge spillover is an essential element in innovation and in the development of the system of innovative relationship, like in clusters. Although, the high geographical concentration of firms, universities and research

centers in a region belonging both to the same or different sectors, is not enough to explain the innovation capacity of a local area or an organization (network, cluster). It is necessary to define the channels through which the knowledge spreads. Capello and Faggian (2005) introduced the concept of relational space, and explored the connection between *physical and relational space*, as preconditions of knowledge spillover (Figure 1).

Figure 1. Role of physical and relational proximity in innovation and cluster forming



Source: own construction on the basis of Capello–Faggian (2005)

Relational space is created by the set of all relationship (market, power relationships) and cooperation between firms, different agents and individuals, who are characterized by a strong sense of belonging and similarity. The approaches of physical and relational space are outstanding tools to analyze the innovation process and relationships, as in the case of clusters.

On the one hand pure physical space (Capello–Faggian 2005) is formed by the geographical proximity of firms in the same sector (to exploit localization advantages) firms in different sectors (to exploit urbanization advantages) and typical places where

knowledge is produced, like in universities and research centers. Economic actors in physical proximity have the opportunity to contact each other, where the spread of knowledge and the production of geographical knowledge spillovers are managed more easily. On the other hand relational proximity and its dimensions (according to the original notion of the authors it is defined as cultural proximity) are the base of the formation and existence of relational capital (channel of knowledge spread) which is formed by explicit and implicit cooperation among actors. Actors have the capability to interact and to share common values, which is the fundamental element of collective learning.

4. Software industry related clusters in the European Union

The software industry plays a crucial role in the formation of the Information Society. The initiative i2010 (European Information Society 2010) aims to support the Information Society and the media industries within Europe. The software and IT services industry employs more than 1.000.000 European specialist (ISM 2006), and basically every business in all sectors (especially manufacturing, automotive industry, financial services, insurance and retail) in the European Union depends on it, because it facilitates the development, marketing, coordination etc. The European Union fosters the growth of the software industry, the development of the digital economy, especially in research and in partnership building, and support the formation and development of networking and clustering, through the regional policies.

There are many examples for successful IT and even only software clusters in the developed regions in the European Union: Sophia Antipolis in France, the Dublin IT cluster, the Cambridge Network in England, the Technology Cluster Oulu in Finland (ISM 2006). But there are more and more developed and developing cluster in the less developed regions too (e.g. Cork in Ireland, Ostrava in Czech Republic, Tartu in Estonia).

Software companies continue intensive development activities and ICT allows management and coordination from a distance. What is interesting, that there are very few examples for software-only clusters (ISM 2006). The software industry is often included in a bigger regional high-tech cluster (besides for example to the industry of biotechnology, medical etc.) as a 'supporting industry'. The information and communication technology itself plays a special role in the software industry too, and contributes to its characteristics: products (software and teleservices) have an immaterial nature. They can be developed by a geographically dispersed team and directly be delivered to business partners and consumers by using digital network, which leads to the decreasing of the transportation costs too. It is difficult to determine the economic value of software, and the value of the products and activities added by the software related companies, because these usually are built in a complex, final product.

All of the software and IT service related cluster in the European Union have a unique history and structure. One of the factors that determine the process of formation is the level of competitiveness of the region, where the cluster develops. In the less developed regions (contrary to the developed ones) most of the initiatives have been launched by the local or regional government or by the private sector, where the agencies try to engage industry association and individual companies in their efforts.

In order to survey the opportunity of formation and development of a future software cluster in one of the less developed, neofordist type regions (see Michael Porter 2003) in Hungary, it is indispensable to examine the process of clustering in other less developed (neofordist and knowledge transfer) regions in the European Union. The cases of the IT related foreign clusters in Oulu (Finland), in Cork (Ireland), Ostrava (Czech Republic), Tartu (in Estonia) shows the basic role of proximity in practice in the formation of interactions, cooperation, research and development etc. All of the clusters examined hereinafter operate in a less developed region like Southern Great Plain, with similar geographical expansion, social and economic background.

The formation of software industry in Ireland, especially in the area of Dublin, Cork, Galway and Limerick started as an agglomeration of major ICT companies which invested in the regions in business friendly environment (ISM 2006). In the *city of Cork* the software industry is also largely driven by foreign direct investment (FDI) attracted by the low Irish corporate tax rates, subsidies from the EU. In the region innovation policy was key for cluster development, which promoted R&D and innovation, encouraged spillover of knowledge. Due to this, actors created a 'knowledge zone' in Cork, to maximize the advantages derive from the proximity of entrepreneurs, development agencies (e.g. IDA–Industrial Development Agency) and entities of local and central government (CCC 2005). The first factor, which led to the growth of the region, was the financial resources ensured by the government, especially for infrastructure and prosperous business environment development. The second has happened yet due to the bottom-up initiation and empowerment of the IT related companies and the proximity of skilled work force. The success of the cluster in Cork initially derived from the local companies, that could work together with the foreign companies due to the relational proximity, then later to both geographical and relational proximity, making the cooperation and development more easier, with the formation of the innovation park (National Software Center Campus), the University College Cork and the Cork Institute of Technology.

In the *city of Oulu* in Finland, the foundation of cluster was supported by more factors (ISM 2006): the establishment of NOKIA as a regional and national 'champion' company, the strong and consistent regional and local development policies, and the focus on areas where market failures could be identified. IT cluster in Oulu is one of the most competitive ones, be present on the 'cluster map' of Europe (Morris et al 2005). Key preconditions in the formation of the 'Oulu

phenomenon' were also the geographical and relational proximity, size and quality of the local knowledge infrastructure (research center and the science park of Oulu Technolopis Plc.), the access to qualified labour force (educated in the Oulu Polytechnic, the Oulu Region Center of Expertise). In Oulu substantial public policy efforts too were made the ICT cluster flourish: the central government decentralized its agencies in proximity to the region of Oulu, to see and represent the local interest more effectively (Oulu Congress 2006).

By examining further foreign clusters and initiatives too we would observe the well known fact (which is underlined by the literature and many other surveys) that proximity plays a crucial role in the development of software clusters too, (beside the special characteristic that software companies use ICT tools more effectively). In *Ostrava, in the Czech Republic* it is facilitated to form network of business relations between firms and universities by the creation of IT related industrial areas, technology park and innovation centers to utilize not only the advantages of geographical proximity, but to have more effective knowledge based cooperation based on cognitive proximity (CSKI 2002). Conscious steps are taken to attract labour force, university students and firms to the regions from outside areas to increase the home base of the software industry in Ostrava.

The growth of the IT sector in *Tartu region*, in Estonia happened due to the appearance on foreign markets and to the intensive export activities to the direction of Sweden and Finland (Tartu Region 2007). As suppliers, firms from Tartu can join to foreign IT clusters, may receive the most developed technologies and can have common product development, research. This refers to the existence of strong relational proximity between partners from the Scandinavian countries. These types of cooperation can be also formed by the software companies from Szeged subregion.

5. How much proximity still matters in the software industry in Szeged subregion

To investigate the dynamics of proximity, in particular in the high-tech sector, we focus on the case of the software industry in the less developed region of Southern Great Plain, in the city of Szeged and in its subregion.

The Southern Great Plain (NUTS 2) region is situated in the southern-eastern border area of Hungary. The region is 18,000 square kilometers, biggest region in Hungary with its population of 1,4 million. According to the measures revealing the level of competitiveness of its economy, the region is considered as a neofordist type region (Lengyel 2006, Lukovics 2006). The growth rate of the region is the lowest in Hungary, and the GDP per capita was one of the most lowest between the regions of the EU27[1]. All of the three counties (Csongrád, Békés and Bács-Kiskun) included in the region are underdeveloped, have a workforce with low educational level

[1] www.epp.eurostat.europe.ec

(mostly working in agriculture) and yet have not passed the structural change. The county of Csongrád (where Szeged is located) reaches only about 48% of the average of EU 27.

However this figure cannot be applied to the whole region and the county. The city of Szeged is the so called 'knowledge island' of the Southern Great Plain. Szeged is the fourth most densely populated city (with 160,000 people) in the country, almost 40% of the population in the region lives here, and located about 170 kilometers far from capital, Budapest. Together with its subregion, the labour market is approximately 250,000 people. The characteristics of the city and its subregion differentiate from the rest subregions in the region (Lengyel 2003). The two-third of the workforce is employed in the service sector, the entrepreneurial is 'vibrant', and both the number of enterprises and personal income exceeds the average national level. The rate of the employees with higher education degrees is high (24,3%). More than 90% of the researchers in the county of Csongrád live and work in the subregion. Today the three most important factors, which determine the growth of the region are (Lengyel 2009):

1. The university (the University of Szeged), which as we know, operates in the less developed, neofordist region.
2. The function of Szeged and its subregion as a 'knowledge isle', with the high number of enterprises, the high level of education, employment rate and scientific background.
3. Szeged and its subregion is a knowledge transfer region with qualified human resource, high number of people with scientific degrees, R&D units and expenditures and the number of patents.

The city and its subregion have a very strong scientific and human potential that facilitates the subregion to become not only a knowledge transfer, but maybe a knowledge creation region. The endowments of the key region within the Southern Great Plain region (Szeged subregion) underline the necessity of mapping a software cluster. Sufficient knowledge base is available, ensured by the university background, educational and research activities, the big number of university students (around 30.000 students), newly graduates, and finally by the Faculty of Informatics (with nearly 500 newly graduated students annually). These factors ensure the fluent re-production of the labour base annually, and the birth of new enterprises found by qualified, young workforce. A circle of software enterprises is built, and the first initiatives have already appeared to have more efficient cooperation (cluster) between companies, although the effects of these are still hardly perceptible.

Our aim is to understand how geographical and relational proximity and its dimensions determine the process of clustering in knowledge-based activities in less developed regions. The growing application of information and communication technologies appears to indicate that there is a weakening need for geographical

proximity, and it causes the 'death of distance'. This has not triggered a collapse of 'near and far' in the reality of individuals and organizations, not for actors staying in less developed, peripheral regions (Lagendijk–Lorentzen 2007). Usually, these firms depend on knowledge sources deriving both inside and outside from the region, as we will see in case of Szeged too.

The first step to identify the base of a future software cluster is to map the size of the industry in Szeged and its subregion. If the geographical concentration of the software industry is proved in the number of enterprises and employees, it makes reasonable to examine whether the software companies need geographical proximity or not, and how strong is the relational proximity between software companies.

6. The proof of geographical concentration

The software industry is a potential leading branch in the micro-region of Szeged. Mapping the base of a future software cluster, firstly it is necessary to prove the existence and concentration of the basic input factors in the region. We examine whether the software industry has achieved a specialized critical mass in the region using the cluster mapping method of *location quotient* (LQ) (Patik–Deák 2005). The measurements are based on the entrepreneurial databases of KSH Cégkódtár (2007/2) and Opten Cégtár (2008).

LQ compares the distribution of an activity to some base or standard. In this case the selected base is the employment and the number of enterprises. In Szeged and in its subregion more than 200 companies (which have its seat or/and site in the subregion), and about 550 employees work in the software industry. To focus on the most knowledge intensive companies in the region, who have the biggest role in the growth of the industry, we only examine limited liability and public limited companies dealing with software development (NACE Rev.1. 72.21.), software consultancy and supply (NACE Rev.1. 72.22.) whose products have bigger added value. The software industry in limited sense is composed of 91 companies.

As a rule, if the value of LQ is more than 1, it indicates a relative concentration of the activity in the area, compared to the region as a whole. The European Cluster Observatory determines a stricter value limit equal to 2.

According to the value of *LQ based on the number of enterprises*, which is less than 1 in Szeged and in its subregion, we can state that the area has fewer shares in the software activity than in other regions in the country, in the case of other bigger cities in Hungary (Győr, Pécs, Debrecen, Székesfehérvár). It is interesting that if we not measure the number of enterprises in capital, Budapest (where more than 5000 companies work in the software industry from the 9000 companies in the country), and we count the LQ only in the countryside (in the country without Budapest) the LQ is 1,256 (Table 2).

Table 2. Value of LQ for entreprises and employment

	Entrepreneurial LQ		Employment LQ	
	Hungary	Hungary countryside	Hungary	Hungary countryside
Budapest	1,390		2,171	
Szeged	**0,944**	**1,256**	**1,119**	**2,867**
Győr	0,829	1,104	0,431	1,105
Pécs	1,016	1,352	0,557	1,429
Debrecen	0,858	1,142	0,681	1,744
Székesfehérvár	1,173	1,561	0,898	2,300

Source: own calculations on the basis of data from KSH Cégkódtár and Opten Cégtár

We got similar results measuring *employment LQ*. Taking the number of employees in Budapest into account, the LQ is 1,119 in Szeged and its subregion, and without Budapest it is 2,867. None of the other cities in the countryside can reach this relatively high value. According to this figure, the relative concentration of the software industry is secured in Szeged and its subregion in the number of enterprises and employees. The industry may be strong enough to grow as a *potential leading branch*, and also attract related economic activities from the region itself and from other regions too.

The statistical research based on the calculation of location quotients ensured the observable phenomenon, that software industry is specialized in Szeged and its subregion. It is worthy to note, that the number of employees and enterprises in the software industry in Szeged and its subregion cannot be compared to the size of a traditional industries (e.g. agriculture, food industry in the region). But the results suggest surveying the opportunity of software industry as a potential leading branch for clustering with qualitative research.

7. The role and strength of relational proximity

Using the qualitative method of questionnaire, we examine how geographical proximity matters in the software industry, and how strong the relational proximity is between companies. We tried to contact to all of the 91 companies (headquarters) in the software industry (in the restricted sense), but only 74 companies were available. (It cleared out that some of the companies already not exist.) Finally, 31 questionnaires were sent back. It was not representative sampling, but the 31 questionnaire is 34% of the asked ones, so we can have valid, reasonable consequences. The results represent the characteristics of enterprises with the average number of 12 employees. The questionnaire was created based on the studies of European Cluster Observatory, of the questionnaire of Michael Porter and the literature of proximity. The main areas of the questionnaire included basic

characteristics of firms (year of foundation, employment, profile etc.), and the dimension of the proximity (the presence and intensity of proximity) (Table 3).

Table 3. The measurement of the presence and necessity of geographical and relational proximity

	Measurement
Geographical proximity	Presence and amount of partnership in the subregion, region and country (customers, suppliers, industry related companies - SME or large company, university, research center, goverment agencies, competitors, consultant etc.)
	The amount and the utilizing of advantages deriving from the proximity of input factors (qualified workforce, educational and research institutes, technology, business services etc.)
	Lack of input factors and its effects (business and personal, information, workforce, financial resources)
	Amount of products and services produced and supported to other local industries
Cognitive proximity	Participating in the same programmes, and trainigs, have the same educational or working background of the employees,
	The continuity and intensity of R&D activities and cooperations
	Participating in business clubs, forums, organizations, conferences etc.
Organizational proximity	Number and intensity of business relations within the organizations, and between the organizations (projects, consortium, tendering etc.)
	Number and intensity of personal/informal relations within the organizations, and between the organizations (family, friends etc.) and their effects on the operation and development of the organization
Social proximity	Role and evaluation social background in the operation
	Effects of relations with family, friends or other individuals and their role: - to manage the wished market position - to form and reach the adequate market demand - to have and transfer information and knowledge
Institutional proximity	The effect and importance on the operation of organizations, by factors: - laws, rules, regulations, - cultural norms and habits - corporal routines - the effect and evaluation of the economic and enterprise development in the region

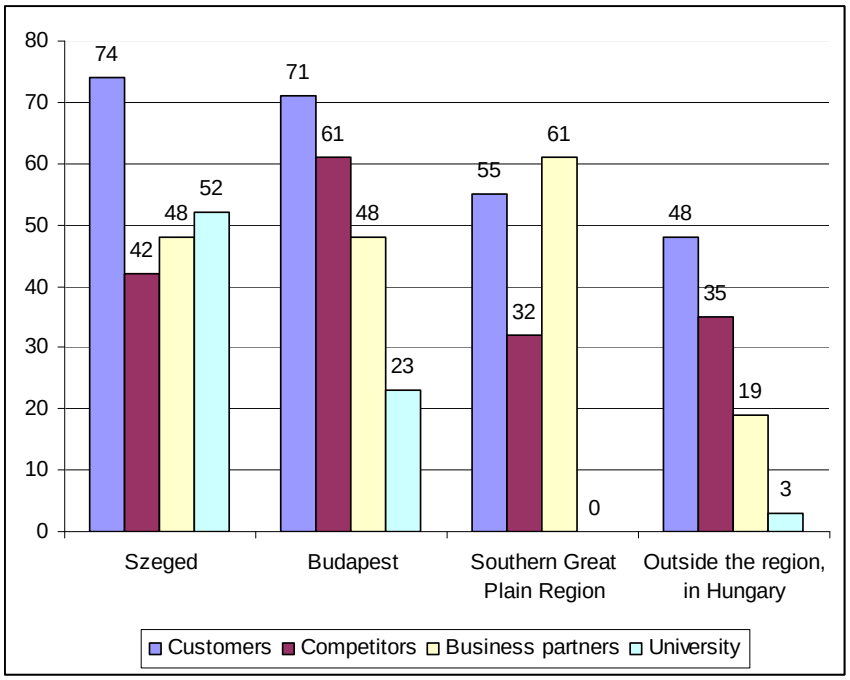
Source: own construction

The questionnaire shows that the role of geographical proximity in the software industry appears in a special way in Hungary. The number and the intensity of business partnership between companies confirm the well known fact, that there are no significant distances within Hungary, and partners in the capital, in Budapest play an important role even in the software industry too of Szeged. More than 70% of the companies have customer relations in Szeged and Budapest too, every second

company have cooperation with the University of Szeged, and only 23% have any kind of connection with universities or research center in the capital (Figure 2).

What is surprising that, about 60% of the companies occasionally work together with their competitors from Budapest. This relatively intensive partnership between the software companies in Szeged and Budapest underlines that they are in relational proximity. Software companies valued geographical proximity as relatively important factor. In a five point scale (1 not important, 5 very important) the average of the answers given to this question is 2,71. Beside the weaker need for geographical proximity there is proved relational proximity between companies. They do see and enjoy the advantages deriving from geographical proximity, but as firms reported, the lack of it does not mean a disadvantage especially in some stages of on-demand software development and services.

Figure 2. Partnership of software companies (%)



Source: own calculations

There are broad market borders among the IT products and activities. Thought many of the distinguished activities can be relocated, but it is quite obvious that at least temporary geographical proximity is necessary in cooperation. The need of permanent geographical closeness depends on the quality of the technical conception of the software being developed. Usually, face-to-face interactions are required in software development, definitely in the initial stage in functional specification, and

in the final stage in integration and technical assistance. Companies in Szeged and in its subregion are solution-orientated. They practice research and development, and focus on design software, instead of making standardized tasks.

The cooperation with *competitors* has special characteristics. Companies in Szeged and its subregion cooperate and compete with each other, like companies in clusters. 78% of companies admitted that the proximity of the competitors inspire them to make developments much faster and more effectively. Almost half of the companies have participated in a project with its rival in Szeged, and about two third in Budapest. Typically the cooperation occurs only occasionally and focuses on research and development, and may be attained by the companies in relational proximity. The software market in Szeged and its subregion is mostly dominated by local partners, no matter we examine the relationship between producers, university, rivals, suppliers or customers.

Mapping a software cluster in the subregion, the survey demonstrates that companies may enjoy the *positive externalities* of geographical concentration, and strive for conscious utilization of its advantages. The need of (at least temporary) geographical concentration depends on the strength of the relational proximity. Relational proximity and its dimensions (cognitive, organizational, social and institutional) are basic inputs in the innovative cooperation. In the questionnaires, companies emphasized three factors, as the most important inputs of innovation: attainment of innovative and professional workforce, ideas and technologies through personal and business relations and finally the proximity to educational and postgraduating programs and institutions. The synergy of partners is substantial to obtain the benefits of innovation-based relationships.

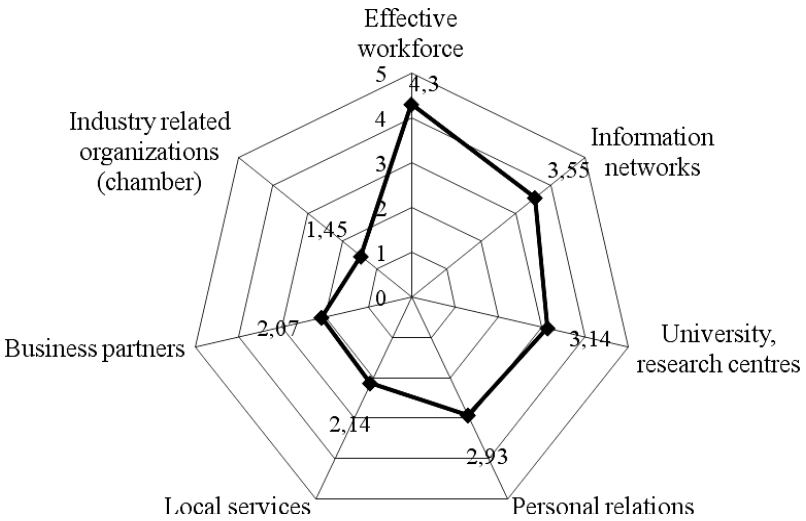
University appears to be an intermediary institution in the flow of knowledge and information, and manages to bring partners to strong relational proximity. It has significant role in the facilitation of collective learning. As the questionnaire revealed, the companies have cooperation usually only with the university. 45% of the companies have regular collaboration with the University of Szeged, and only 5 companies have the relationship with the Budapest University of Technology and Economics or with the Hungarian Academy in Sciences in Budapest. Only one gets in touch with university abroad, within the EU.

Business and personal relations between actors determine an 'industrial atmosphere' in Szeged subregion, where the similarities in knowledge background, experience, practices and routines are natural. Cognitive proximity is a pivotal factor in the software sector in Szeged. More than half of the employees and almost 80% of the headquarters of the companies graduated in the University of Szeged, on the Faculty of Informatics. Companies with the same knowledge background participate in forums and clubs (52%), conferences (39%) and other professional programs together. It is favoured to have interaction between company members, because they share a set of common rules, specific know-how and organizational routines. This points out that they stand in organizational proximity too. Different forms of

interactions play an important role: the lack of personal and business relations (33%), governmental subsidies (29%) is – as the interviewed firms mentioned – factor that hampers their future chance to grow. More than 80% of the companies stated that personal relationships like friendship of employees within and between organizations ensure the flow of information and knowledge. Furthermore they (39%) emphasized the importance of informal relationship between headquarters and employees, - formed in expositions, conferences - as a channel of information flow. This process would not be managed without socially embedded relations. Strong social proximity facilitates the affirmation of links, the development of trust-based relations, hence the formation of innovative cooperation.

Software companies are characterized by *intensive innovative activities,* and do own research and development (65%). In the past 3 years 87% of them have done innovation, basically product (65%) and technology development (48%), appeared in a new market (45%) or participated in professional trainings (42%). 10 companies restructured its organization, and only 7 bought and not developed its technology. The questioned firms valued also the factors, which has the biggest effects on their innovation activities (Figure 3). The results underlined the importance and proximity of qualified workforce, sources of information, personal relationship, university and research center, and the role of local business services and organizations (like chamber of industries and commerce) in case of this too.

Figure 3. Factors influencing the innovative capacity of software industry



Source: own calculations

The *profil*e of the companies is very *heterogeneous*, but there is need to support and inspire them to do innovation together for the local industries. Some

already sell software and IT services to the food, medical, medicine industry and biotechnology, but these kind of cooperation are still less intensive. If the software companies have permanent connectivity to other local industries, it can also decrease the cost of collaboration.

The problem faced by the software industry in Szeged and in its subregion is, that the relations are not results of constant or recurrent cooperation. They are supposed to receive financial sources within a common project or trade development competition. Companies in general are not willing to have regular cooperation, because they fear to loss their market position or to have their good ideas stolen. However, they already stated (68%) that they would be ready to work together within a cluster. Solving the problem, the key is to draw up a conscious development strategy creating the synergy between partners (software companies, university and other knowledge producer institutions and the representatives of local government).

Companies in macro-level are embedded in one institutional background. They are in strong institutional proximity; they are applied to the same laws, rules and regulations. However actors' satisfaction in connection with institutions is a very different question. Interviewed companies valued some related factors with a 5 point scale (1 not satisfied, 5 very satisfied). They are discontent with the administrative obligatory (1,57), legal environment (2,03) and with the representation of their interests (1, 72). Local government does not have the sufficient tools to promote relation e.g. with industrial parks, cluster building, the foundation and registration of new firms, the appearance in external markets, the organization of trainings, clubs and the development of technological infrastructure.

These experiences can be traced back to the lack of a conscious cluster development policy in Hungary. Some policy tools are already included in the central economic development programs, but only a few steps were made to focus only on clusters, not only on national, but even in regional level, in harmony with the bottom-up initiations of enterprises in different sectors (Grosz 2006). By drawing up adequate cluster development orientated plans, and having a consensus made by the private and public sector, the default may eliminate. The process of cluster development may speed up due to an effective institutional and governmental background. Governments contribute to diminish market barriers, control market competition, ensure inputs (eg. infrastructure, technology etc.) for economic actors and mediate between companies and institutions, which produce knowledge and labour force. Thus, government may facilitate the cooperation of companies in clusters too.

8. Conclusion

In Szeged subregion it became reasonable to explore the opportunity of the formation of a potential clusters in the software industry. The existence of the

relative geographical concentration and the home base of the software industry in the amount of enterprises and employees in the ‘knowledge isle’ of the Southern Great Plain were proved.

Findings ensure the importance of both geographical and relational proximity between the actors in the software industry in Szeged and in its subregion. Proximity has a positive effect on the innovative capacity, the development of corporate skills and the decreasing of transaction costs. The pool of researchers and qualified labor force has been built-up; companies are motivated to deepen their existing business relations, which determine the formation of the critical mass of a cluster.

Qualitative survey revealed that geographical concentration is necessary, but not sufficient to create business and non-business relations in practice. At least temporary geographical proximity and strong relational proximity of the partners is needed to create cooperation with the aim of software development.

There are two main reasons, which explain the intersection of the weakness or strength of geographical and relational proximity between software companies. Firstly, the number of collaboration of software companies in the region and between regions in Hungary (mainly in Budapest) reveals the need to access knowledge sources formed outside the region too, especially in case of a less developed regions. Secondly the software industry cannot be compared to a traditional industry. There are immaterial products, which may be developed in bigger geographical distances too, and can be transferred to anywhere by the information and communication technologies. Furthermore the necessity of face-to-face interactions depends on the stage of the cooperation with the aim to develop new products or technologies.

Relational proximity and its dimension together and separately define cluster formation. Software companies are in cognitive proximity sharing the same knowledge background, having the same or similar university origins, and participating in conferences, clubs and forums. They have an extensive system of business and personal relations, determined by the same behaviour patterns, cultural and social values, rules and regulations, which underline the existence of organizational, social and even institutional proximity between them. Each dimension of relational proximity separately and also together affects the capacity of innovation and collective learning.

There is a lack of more trust-based relations and partnership of companies, local government and knowledge producer institutions, but it can be counteracted by not only occasional, but also frequent cooperation, and by conscious economic and enterprise development, which is absolutely important in a less developed region.

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IPR Protection Strength and the Market for Knowledge

Benedek Nagy

The world of today is called information society. This means, that information, knowledge and achievements of the intellect are gaining in importance in production over the more conventional factors of production like labour or capital. Who has the knowledge and the know-how, also has the advantage in competition.

Knowledge or intellectual products have, however, characteristics of a common good, which preclude its trade, and hinders specialisation in its production. Knowledge is common good inasmuch as there is no rivalry in its use, and also no natural excludability. Intellectual Property Rights (IPRs) are an artificial way to at least partial excludability which can – beside encouraging innovation – render intellectual products tradable.

In this paper I am going to focus on the trade related aspects of intellectual property rights from an institutional economics point of view. I intend to explore the relationship between tradability as determined by the strength of the actual IPR regime and the intensity of trade in intellectual properties across countries. I am exploring the theoretical basis for the relationship between international mobility of intellectual products and the country's IPR regime. Based on models and cross-country empirical data the strength of intellectual property rights does influence the magnitude of trade of intellectual products between countries. My hypothesis is, that when a country's IPR regime becomes stricter relatively to its trading partners, this facilitates the inflow of knowledge to the country. This is the technology transfer that can help developing countries to grow.

Keywords: intellectual property rights, patent, international trade, efficiency

1. Introduction

In the last decades it becomes increasingly clear, that those countries will be able to benefit from the new kind of international competition which can better adapt to the challenges of the knowledge-based economy. Knowledge is gaining in importance as an input to the production process. Therefore it is in the best interest of the countries and governments to facilitate knowledge production and try to manipulate its international spread in their own favour. This paper uses an institutionalist point of view to show how this can be done by an appropriately formulated intellectual property rights protection regime.

Intellectual property rights, or property rights more broadly, are institutions which are taken as given or exogenous by neoclassical economic models. In this paper, however, what is seen to influence important economic outcomes is the

design of this institution itself. Therefore I have to tackle the problem from a different point of view.

The New Institutional Economics seems a good choice. Institutions have always played an important role in the life of mankind, but their economic aspects have just recently started to be explicitly investigated. Starting with the influential works of R. H. Coase as far back as the 1930s, the new institutional economics a) views institutions as not being neutral, but influencing economics outcomes, b) rather than discarding the whole apparatus of the neoclassical economics, tries to link functioning of the institutions with the marginalist methodology and c) tries to use institutional variables as endogenous within the neoclassical framework. Thinking about property rights and their causes and effects has a long tradition in philosophy, dating back of course to the Greeks, to Aristotle. This line of thinking found its way to economic thinking only recently. In his 1960 paper, the Problem of Social Costs, Coase emphasises the economic importance of property rights. The famous Coase-theorem about how clearly established property rights enhance the efficiency of the market system in the presence of externalities is already a part of most every undergraduate microeconomic textbook. In the next decades numerous distinguished scholars such as Armen A. Alchian, Harold Demsetz, Douglas C. North, Oliver Williamson and Richard A. Posner – to name just a few – contributed to this new economics of property rights.

Property right in economics means "actual power to control or affect the use of an object, of some aspect thereof" (Makaay 1999, p. 247.). This controlling or affecting can typically mean 3 things: a) usage of the object (usus), b) appropriating the returns thereof (usus fructus) and c) the transferring of these rights partly or fully to another person (abusus). Clearcut property rights and their guaranteed enforcement are perquisites of a well-functioning, Pareto-optimal market economy. If any of these essential rights is restricted, either by a government authority or by the nature of the object of the property rights, efficiency can not be warranted.

The third of these rights is in connection with the freedom of contracts and trade. As Makaay writes (1999, p. 248., italics mine): "A person who controls the use of an object may find it *profitable* to allow another person to use it, or to exploit it with the help of another person. To this end, the owner enters into an agreement with the other person. The agreement defines the permissible uses for the other person, and thereby *confers* on him or her *some economic property rights*." The above quote implies, that both using our property ourselves or selling it to someone is driven by the profit-motive and leads to the efficient usage of the property. If there are any limitations to any of these parts of the property (that is, limiting the economic property right that can be conferred on someone, or limiting this conferring itself), efficiency cannot be ascertained.

We also have to be aware of the fact, that the property right system is not static, but dynamically changing. Since it is, in the institutionalist view, an endogenous variable, it is not merely a given factor that determines other variables,

but is itself dependent on other economic variables and processes. The emergence of new kinds of objects with new characteristics requires the emergence of appropriate property rights. The tailoring of property rights to the characteristics of the different objects can be a natural, evolutionary process, left to the market, but more often than not it is done by the government.

In the first section I identify special characteristics of intellectual products which the appropriate property rights system has to handle to be able to facilitate trading. In the second section I present predictions on the model-level and findings on the empirical level how the system of property rights influence trade. The third section compares the cross-country empirical results to the Hungarian situation. Throughout the whole paper I will concentrate not on the built and structure of the IPR protection system, but only on its strength.

2. Special characteristics of intellectual products and intellectual property rights

Intellectual products differ by their very nature from physical products in some important aspects. The most important of these for us now is their being common goods. This means, that there exists no rivalry in the usage or consumption of intellectual products. Once a certain piece of an intellectual product has been produced – written, invented etc. – it can be used even simultaneously in more production processes without any one specific usage precluding any other. Considering knowledge a common good in this sense supports the argument that knowledge should be freely available for anyone and everyone. It has been quickly recognised, however, that the producers of intellectual products will not be sufficiently interested in producing them if they can not appropriate the returns from their inventions due to their non-excludability characteristic as a common good. Based on this recognition, intellectual property protection by way of property rights appeared in England for example as early as the 14th century (David 1992).

The role of intellectual property rights is to artificially create shortage in the case of a product where scarcity is necessarily absent by virtue of the nature of the product (May 2005). This artificial scarcity serves as a basis for the (at least partial) excludability of intellectual products, and enables the (again at least partial) appropriation of the returns thereof. By creating excludability, intellectual products are rendered tradable, price can be set for their usage, which may result in profit for the producer of the intellectual product. This kind of partial excludability is indicated by the name quasi-common good.

The goal of the different instruments of intellectual property rights protection – patents, trademarks, copyright – is to make it rational to invest resources in the production of intellectual products, meaning the “promot[ion of] the Progress of Science and useful Arts “ by “securing for limited Times to Authors and Inventors

the exclusive Right to their respective Writings and Discoveries." (David 1992, quoting the constitution of the United States).

Many studies exist that show how the patent system can foster the *creation* of intellectual products, or knowledge, starting with the seminal works of Arrow (1962) and Nordhaus (1967). In this paper I am more interested in how the patent system, more broadly, the intellectual property rights system influences *trading* in knowledge.

Intellectual property protection aims not only at protecting the creators of new intellectual products – this was also not the main reason for which it was used in the 14th century England mentioned above – but at encouraging the spreading of new knowledge. Clear property rights allow of trading. Market prices which can be set due to excludability encourage not only efficient production, but also efficient allocation, which means that by the logic of the market mechanism the intellectual products will find their way to the most efficient users through trading.

Intellectual products have some important characteristics that can be identified as influencing their tradability[1]:

1. Appropriability, meaning the possibility that the inventor be the exclusive beneficiary of the profits from the invention.
2. Fungibility, meaning the possibility to simultaneously use the same unit of knowledge in more than one production processes.
3. Complexity, meaning the diversity of complementary pieces of knowledge required to generate a new piece of knowledge.
4. Cumulability, meaning complementarity between the already existing stock and the new flow of knowledge.
5. The stickiness of knowledge to human capital and routines (Antonelli 2004, p. 423.).

An intellectual property right regime has to be able to adequately handle all these characteristics in order to enable efficient trading on the intellectual products' market.

Trading in intellectual products involves transaction costs both on the supply and demand side. These costs cover the cost of finding the right trading partner, that is, the cost of inspecting the quality and expected usability of the ware to be traded, of the elimination of opportunistic tendencies and the risk of inappropriable derivative returns (Antonelli 2004, p. 423.).

[1] Tradability can be defined, following Antonelli (2004) as the degree to which a certain intellectual property without physical form can be bought and sold on the market.

3. Intellectual property protection and trading with intellectual products

Establishing a clear intellectual property rights (IPR) system makes trading with intellectual product possible. The possibility of trading in turn leads to specialisation, meaning that it is no more necessary for everyone to produce knowledge and innovate for themselves, but the production of these can be done by specialists having comparative advantage in their production. Knowledge can then be acquired from these specialists through the market. Research and development can be detached from production. Producers can have the necessary knowledge and technology from the researchers, and researchers do not have to bother with the commercial development of their ideas, like they had to in earlier centuries (Lamoreaux–Sokoloff 2001). The separation and cooperation of the two spheres are rendered possible by the market for intellectual products by way of intellectual property protection measures.

In this section I am talking about knowledge transfer in a very general sense. The model I introduce and the empirical test of its predictions are at the macro level. These do not say anything about the actual process, how knowledge is being transferred from one country to another. Neither is it important here, how individual firms find out, what knowledge and what innovations it is worth to acquire from outside the home country, or what determines the regional spreading of knowledge and innovations. Although these are all certainly important questions, I will concentrate here only on the aggregate, macro level.

There exists a number ways to transfer knowledge from one country to another. "International technology transfer refers to the process by which a firm in one country gains access to and employs technology developed in another country" (Falvey–Foster 2006, p. 23.). This has many ways and methods, that can and has been both theoretically and empirically explored. The possible ways include international trading in technology-intensive products, international flow of foreign direct investments, cross-country licensing, or even patenting in a different country.

International trading in intellectual products is one these market-conform way technologies can spread in the globalised world[2]. The same way it is important for a domestic market of intellectual products to clearly establish property rights, international trading in intellectual products is strongly influenced by the relation of the different national property rights regimes. As to how exactly national differences in the strength and design of the IPR system influence international trade in intellectual products, no generally accepted theoretical explanation has yet emerged in the literature.

[2] As opposed to certain non-market-conform ways like non-market transactions and spillovers (Falvey–Foster 2006)

4. Modelling the link between IPR regimes and technology transfer

There are at least two characteristics of a country's intellectual property rights regime, that can influence the inter-country flow of intellectual products, namely its design and its strength. The first model I will cite here shows how the design of the system influences trade (although differences in design can be translated into differences in terms of strength), and the second model will concentrate on the system's strength or strictness as an important determinant variable.

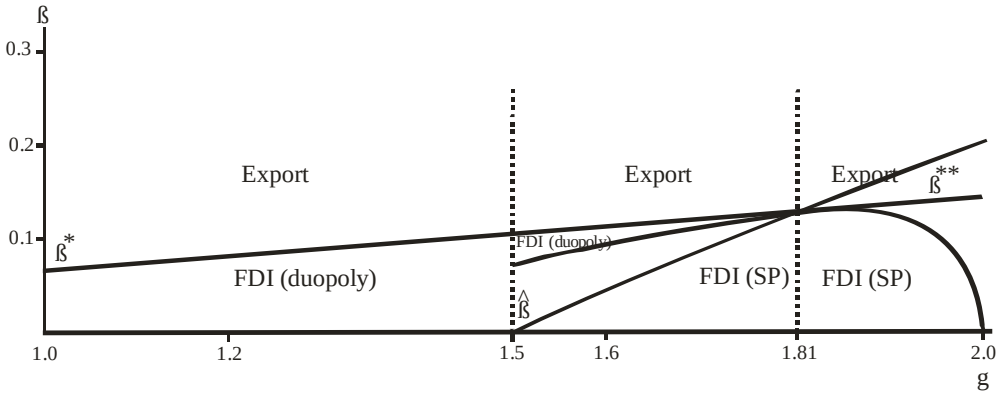
Building on the work of Dornbusch et al (1977), Taylor (1993, 1994) models at the macro level, how the strength of an IPR regime influences international trading in products and services and intellectual products. The model is a Ricardian trade model, where production and R&D is carried on in the different countries based on the relative factor costs. International trade then may or may not equalise factor costs in R&D depending on the institutional setting. Taylor finds, that there is „a link between asymmetries[3] in patent protection [between countries] and resulting trade distortions" (Taylor 1994, p. 363.). His model finds, that „Asymmetric protection of intellectual property rights: (1) distorts the pattern of trade in both goods and R&D, raises the relative wage rate of the country that imported R&D, and eliminates technology transfer between countries; (2) lowers the amount of labour allocated to R&D activities worldwide. […] (3) lowers R&D in the country that exported R&D, and raises R&D in the country that imported R&D." (Taylor 1994, p. 374.). It is important to observe, that the second statement is in connection with the encouraging role of IPR protection in the production of intellectual products (and its role in promoting economic growth, in turn), the first and the third makes a statement about the role it plays in influencing international trade in these. The first statement is especially remarkable as it establishes a link between the relative strength of IPR regimes and the trade in conventional goods and services. The model's third prediction basically means, that if a country's IPR regime discriminates against innovations made abroad, and the country is one that originally imported knowledge from outside, he will be less able to do so, and has to conduct R&D himself, even though he has comparative disadvantage.

What is more important in Naghavi's 2007 model is the explicit differentiation of the more developed North, capable of conducting R&D, and the less developed South, willing to acquire knowledge from the North directly or indirectly. Naghavi shows, that the looseness or strictness of the IPR regime in the South not only influences knowledge flow between North and South, but also determines for the North the more profitable way to enter the Southern market. In his model, trading with goods embodying new knowledge is an indirect way for the

[3] He defines the IPR regimes symetric if results of research and development conducted in another country enjoys the same degree of protection domestically, as those conducted domestically, and asymetric if the regime offers protection only for those intellectual products whose researches are conducted domestically Asymmetry therefore means a difference in the scope of the protection.

South to acquire new technologies through imitating or reverse engineering, while Northern firms' investing directly in the South makes copying the new technology easier. For the Northern firm, this two ways of entering the Southern market are complementary: by exporting it incurs tariff costs, but lowers competition as the technology itself is not readily available for copying in the South. In the FDI case transportation costs can be spared, but only at the cost of higher competition because of imitation. The model finds two bottom-line variables determining the export versus FDI question for the North: efficiency of the R&D project in the North indicated with g[4] and the level of technology spillovers in the South marked β,[5] which is an institutional variable to be set strategically by the South[6]. Figure 1 shows how these two variables determine the way Northern firm enter the Southern market, that is, the channel through which knowledge is being transferred from one country to another.

Figure 1. The Northern firm's decision about the way of going multinational



Source: Naghavi (2007, p. 69.)

β shows the strength of the IPR regime in the South. Higher values mean less strict protection. β^* shows the value at any g, at which it the North is indifferent between exporting to the South or investing directly abroad. If β is smaller than that (more strict IPR protection in the South), it is more profitable to invest directly, and spare tariff costs. If exporting is the outcome, the Northern firm becomes a monopoly in the South, in the FDI case, however, a duopoly arises. $\beta\hat{}$ is the threshold value, under which it is not profitable to the Northern firm to access the Southern market through FDI and β^{**} is that level of IPR protection, under which it

[4] Meaning basically how a unit of R&D cost incurred by the North reduces Northern production costs.
[5] Meaning in turn how a unit of Northern R&D cost reduces Southern production cost.
[6] The variable β itself is the product of the imitation costs b and the strictness of the Southern IPR protection regime ι. The model takes b as given, it is thus only scaling the effects of the actual institutional variable to be set.

is profitable for the Northern firm to invest directly, but it should spend as much on R&D that it becomes unprofitable for the Southern firm to compete, and a restrained monopoly situation arises. In sum, a low β value is supposed to induce more R&D in low-tech industries (crowding out exports, though) and stimulate high levels of R&D spending in hi-tech industries. Thus both in the case of less and more technology-intensive industries it is rational for the Southern government to pre-commit itself to a strict IPR regime, as it induces transfer of technology to the South (Naghavi 2007, p.71.)[7].

If the differences in national IPR regimes do have an impact on international technology diffusion, then their appropriate fine-tuning can become a new way of competition between countries and also a new possibility for levelling off. Endowment with or accessibility to knowledge might be less predetermined, constrained than endowment with natural resources, capital or labour. If it can be proven that the type (strength) of IPR systems as a new tool in the hand of a national government can influence international flow of capital and technology transfer, than using Ghosh's words we can speak of a „new mercantilism", of a new tool a government can use to compete more efficiently at the international level (Ghosh 2003, p. 85.).

5. Empirical studies of the link between IPR strength and transfer of technology

To test empirically, whether a link between the strength of IPR systems in a country and transfer of technology to that country could be established, two questions have to be answered: first, how to measure the strength of national IPR regimes, and second how to measure the magnitude of transfer of technology.

For the measurement of the strength of IPR regimes, Ginarte and Park developed a composite index in their 1997 paper[8]. Their index measures IPR strength along 5 dimensions, giving a number 0-1 to each, and then taking the sum of these to be the Ginarte-Park index, later referred to simply as Patent Right Index. The five dimensions are coverage (meaning what can and what can not be subject of protection), membership in international treaties (the Paris Convention, the Patent Cooperation Treaty and the International Convention for the Protection of New Varieties of Plants), enforcement (whether the legislation provides adequate

[7] Naghavi also shows, that stringent IPR protection does not only attract more FDI to the South and induce higher levels of R&D in the North, but also enhances Southern welfare more, than does a looser IPR regime.

[8] Beside this Ginarte-Park index, empirical studies use another, called Rapp-Rozek index to which due credit is given both in Ginarte–Park (1997) and Falvey–Foster (2006).

mechanism for the law to be enforced), and restrictions to exercising IPRs (eg. compulsory licensing), and duration of protection.[9]

For the measurement of the magnitude of transfer of technology many different indicators can be used. Falvey and Foster (2006) enumerate 4 basic channels through which technology can flow from one country to another, and that is through international trade, through foreign direct investment, through licensing agreements and through cross-national patenting.

In their original study Ginarte–Park (1997), the aim of the study was to examine, what determines the Ginarte-Park Index as a dependant variable. In Park and Lippoldt (2003) the authors conducted an empirical study to examine whether a statistical relationship can be established between the strength of IPR regimes as an independent variable and technology transfers, either in the form of foreign direct investment or in the form of technology-intensive merchandise import. They conducted a regression analysis where they use the above mentioned Ginarte-Park Index to measure the strength of the IPR system as an explaining variable. Beside that, their regression analysis has many control variables (like country-risk or per capita GDP), accounts for individual, country-specific effects like culture or quality of institutions (Park–Lippoldt 2003, p. 16). The countries involved are grouped into two groups of developed countries and least developed countries. Table 1 shows the percentage change (and the significance level in brackets) in inward and outward foreign direct investment (FDI), and exports and imports due to a one percentage change in the strength of IPR regimes (as measured by the Ginarte-Park index).

Table 1. Ginarte-Park Index elasticities

Effect of strengthening Patent Protection on…	**All countries**	**Developed countries**	**Least developed countries**
Inward FDI to GDP	0,49 (p=4,4%)	0,73 (p=1%)	2,76 (p=2%)
Outward FDI to GDP	1,69 (p=0,0%)	1,90 (p=0,0%)	6,11 (p=0,1%)
Exports to GDP	0,172 (p=16,6%)	insig.	insig.
Imports to GDP	0,315 (p=1,1%)	0,243 (p=14,4%)	insig.

Source: Park–Lippoldt (2003)

The effects of increasing the IPR index raised both inward and outward FDI for both country groups, and the effect was stronger for the least developed countries. The result thus is, that a rise in a country's IPR index will on average rise inward FDI and technology intensive merchandise imports to the country. The IPR index had only a moderate effect on aggregated import and export, and this effect was not even significant for the least developed countries. This leads the authors to the conclusion, that intellectual property rights protection affects exports and imports only in a very roundabout way, and on the other hand that trading and direct

[9] In a 2008 paper (Park–Lippoldt 2008), this patent right index is developed further, and an index for the strength of copyright protection and trademark right protection is included.

investments function as complementary in the case of technology transfer[10]. This latter conclusion is completely in accord with the results of Naghavi's model.

Strengthening the IPR systems can contribute to the flow of technology transfer towards the developing countries (Park–Lippoldt 2003, p. 8.), be it either through foreign direct investments or the import of technology-intensive commodities. The strength of intellectual property regime is however not the only determinant of knowledge diffusion. Some other influencing factors, the effects of which could even be studied at the model level might be the extent of the market, the quality of the labour force, the infrastructure, political stability etc.

Even if we take the strictness of IPR protection as a determinant of knowledge inflow into a country, it may not be the absolute, but the relative strictness of the protection that matters. In the next section I will use the Ginarte-Park index of countries to measure the differences in the strictness of IPR protection between trading partners, and see whether and how this influences knowledge inflow as understood by Park and Lippoldt (2003, 2008). I will use Hungary as a target country. Based on the above studies of Park and Lippoldt, my prediction is, that as Hungarian IPR protection gets stricter relative to that of its trading partners, this encourages knowledge inflow, while as it gets looser, it discourages knowledge inflow.

6. Patent Right Index and technology transfer in the case of Hungary

Neither the original 1997 study by Ginarte and Park, nor the 2003 study by Park and Lippoldt includes Hungary. Park in his 2008 paper (p. 2.), however gives the values of the Ginarte-Park index for Hungary. For the years 1960-1990 Hungary scores an average of 2,20. For the year 1995 the index is 4,04 remaining unchanged for 2000, and rising to 4,5 to the year 2005[11]. Having the scores of the patent right index for different years, and having the model of Park–Lippoldt (2008), we can see, whether the Hungarian data support my predictions. Park–Lippoldt (2008) has the methodology of what to measure and how to measure. They regress a) stock of inward FDI, b) technology-intensive merchandise imports and c) technology-intensive service imports to the Ginarte-Park Index of Patent Rights. In their paper, they use data from altogether 120 countries, which they divide into three groups: developed countries (25), developing countries (68, including Hungary) and least developed countries (27). What they find is, that 1% rise in the Ginarte-Park index is

[10] Falvey and Foster (2006) also enumerate (p. 25) many other ways how technology transfer can be measured with the corresponding methodological difficulties.

[11] The Patent Rights Index for Hungary is, however, different, being 3,71 in 2000 and 3,37 in 1995 (Park – Wagh 2002, p. 40.). Partial figures are: 0,71 for Coverage, 1,00 for Duration, 0,67 for Enforcement, 1,00 for Membership in International Treaties and 0,33 for Protection from Restrictions on Patent Rights.

accompanied by a 1,65% rise in inward FDI to developing countries (as opposed to 11,2 to developed and 1,66 to least developed countries). A 1% rise in the Patent Right Index goes together with 1,34% rise in merchandise imports to developing countries (compared to 9,86 to developed countries and 0,54 to least developed countries). Also, the coefficient for service imports to developing countries is 0,99 (9,99 to developed countries and 0,97 to least developed countries). They also give coefficients in a sectoral breakdown: they list those parts of merchandise imports and service imports which are the most likely to bring along with them the transfer of new technologies, and see how these are related to the strength of the IPR system[12]. In the case of the merchandise imports these are: pharmaceuticals, office and telecom equipments, organic and inorganic chemicals, electrical and electronic products, aircraft and spacecraft-related products and optics and precision equipment (Park–Lippoldt 2008, p. 37.). In the case of services imports they list communication services, computer and information services and royalties and license fees (Park–Lippoldt 2008, p. 43.). I also acquired data for Hungary in these categories.

Table 2 shows foreign direct investment, technology-intensive merchandise import and technology-intensive services import for the years 2000 and 2005 into Hungary. As a reference, I indicate in the first column the Ginarte-Park index for Hungary.

Table 2. Knowledge transfer to Hungary

Year	G-P Index for HU	Inward FDI	Technology-intensive merchandise import	Technology-intensive services import
2000	4,04	**22 869,9**	**16 101,3**	**461,0**
2005	4,50	**61 970,1**	**32 842,4**	**1 956,8**

Note: All boldface numbers are in million current USD
Source: MNB, KSH, UNCTAD

It is important to note here, that Hungary fits the original Park–Lippoldt prediction inasmuch as a rise in the IPR index from 4,04 to 4,50 is in fact accompanied by an increase in technology-intensive merchandise and services import to Hungary. My objective now is to see where these merchandise and services come from: do they come from countries where intellectual property rights are strongly or loosely protected? Do they come from countries that have a stronger or looser IPR regime, than Hungary? Is this inflow of merchandise or services sensible to changes in the absolute IPR protection strength or its relative state to the trading partner?

Having data of the above categories broken down to countries of origin it is now possible to see, whether any connection can be seen between change in Hungary's relative IPR strength to its trading partners and the change in stock of

[12] The model certainly also uses control variables.

inward FDI, technology-intensive merchandise imports and technology-intensive service imports, respectively. To see this I used data for only those countries, for which Park (2008) gives a Ginarte-Park index, which is, 120 countries. This means, that in the case of inward FDI, in 2000 88,1% and in 2005 90,3% of the whole inward FDI is covered. In the case of the technology-intensive merchandise imports, this means 99,46% and 98,64%, respectively, and in the case of the technology-intensive service imports, 98,57% and 97,56%, respectively. From the sample I excluded those items, where trade or FDI stock was 0 in at least one of the years, and also excluded outliers, where the change in either way was more than tenfold during the five-year interval. After these exclusions my data account for 86,7% of the inward FDI stock in 2000 and 76,68% in 2005, in the case of merchandise import these percentages are 99,45% and 98,58, respectively and for the services import they are 97,28% and 83,42%, respectively. I took into account further variables that could also have their effect, like the absolute value of the IPR index or GDP growth.

According to my prediction if Hungary employs a relatively stricter IPR protection regime as a trade partner country, technology-intensive merchandise and service import and FDI from that country should increase.

Statistics, however, do not show any discernable relationship between the change in relative IPR strength of a partner country and the change in the value of technology-intensive merchandises coming to Hungary from that particular country. All the variables together explain only a tiny percentage of the change in technology-intensive imports and FDI inflow.

This could on one hand be interpreted, that a change in the trading partners' relative IPR regime strengths can in and by itself not determine the magnitude of knowledge inflow, and is not even the most important factor determining it. It seems odd, however, that while an increase in the strength of IPR protection does attract more knowledge from outside, we cannot attract significantly more just by putting ourselves in a relatively better protected situation. On the other hand this could mean as well, that inflowing knowledge requires a certain level of IPR protection, and once it is reached, Knowledge can be imported regardless of the level of IPR protection in the exporting country.

Still the data show that the higher the partner countries score on the independent variable (relative IPR strength), the greater the upward spread of the dependent variable (knowledge inflow in the various above mentioned forms) can be. This could be meaning, that the change in the relative IPR strength does not, per se, determine technology transfer through these channels, but a greater positive change in Hungary's relative IPR strength is able to *allow for* higher technology transfer, while the smaller the positive change or the greater the negative change, the less it is able to do so. It is also possible, that the data are heteroskedastic, meaning that countries to the right has better chances of exhibiting higher growth in knowledge transfer than countries to the left, for some reason in connection with

their scoring higher on the independent variable, but this heteroskedasticity hypothesis can not be tested on this model.

This model should be extended and studied further. The main task to be done is identifying further variables that influence knowledge inflow to Hungary from the trade partners. My aim is to identify country groups that behave significantly differently than other countries, when it comes to transferring knowledge-intensive products and services to Hungary.

On the international level, there are continuous efforts being taken to facilitate the mobility of this quasi-common good. The institutional measures are trying to benefit everyone, including the seller and buyer country of the intellectual product, and also its creator.

One field of these efforts are The Trade-Related Aspects of Intellectual Property Rights (TRIPS) treaty proposed by the World Trade Organisation. This aims at the international harmonisation of national IPR regimes. The treaty was signed at the Uruguay round of GATT/WTO, and entered into force on the 1st January, 1995. This treaty prescribes minimal standards for national IPR legislation, specifying also some exceptions. Second, it also includes rules regarding the enforcement of the treaty. Third, it also designs a dispute resolution mechanism. It would however exceed the scope of this theoretical paper to examine the effects of the TRIPS agreement on the international market of intellectual products. This way, the trade-distorting effects of different national legislations can be circumvented.

A second field is the development of the institutional foundations of the trade in intellectual properties, including ways for example to reduce transaction costs.

7. Conclusion

Theoretical studies show, that the actual shape and built of a nation's intellectual property rights protection system can and does have effect on the international flow of intellectual products through the markets. Stronger IPR protection attracts more intellectual products into a country.

My objective was to test if there is a link between the strength of a country's IPR protection system *relative to the partner countries* and knowledge-intensive import from that particular country. If this is the case, different countries can shape their IPR regimes to profit more from the international flow of knowledge, while this can be a disadvantage for others.

In the case of Hungary, however, I found no such link of any significance, which could possibly mean, that if an IPR protection regime is strong enough in absolute terms, certain units of knowledge can be imported, otherwise not, regardless of how much the protection is stronger than this threshold value. The international efforts to standardise IPR systems indicate, that differences in relative strength still have some effect.

It is thus up to further studies to examine, *how exactly* varying relative strength of IPR systems influence technology transfer of the above mentioned kind, or other kinds, like the international flow of knowledge workers and human capital, and the resulting knowledge products as embodied in patents or copyrights.

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Manageable and Unmanageable World Crises (Climate and Economy)

Károly Kiss

This study examines the two world crises, climate change and the financial meltdown, followed by an economic depression, and compares how they can be managed. Climate change has set in and to most probability it will cause immensly big damage, human suffer and loss. Still, for the time being international community is not suited to avoid it. In contrast to this, huge efforts, including international co-ordination, are made to combat the financial and economic crisis. This comparison is astonishing: why is there a sudden solution for the one, and why there is not for the other?

As concerns climate stabilization the main question is whether present mainstream economics, interest relations, moral patterns and international institutions give an adequate framework for the solution. The economic crisis also raises basic questions concerning mainstream economics and economic policy: Can bankers' greed be tamed or it is part of the system? Are crises inevitable? Can better co-ordnation on the international level solve the problem? The combination of the management of the two crises is also examined: whether is there a green way out from the crisis. But to save the world economy via a green energy revolution also seems to be a questionable enterprise.

Keywords: financial crisis, climate crisis, manageable, unmanageable, green way out, regulated capitalism, temporary taming

Was the Earth a bank, it has been
already bailed out long ago.
(the Greens)

1. Climate crisis

In the Intergovernmental Panel on Cimate Change of the UN experts of almost all countries participate on an equal parity. The credibility of the reports is underlined by the fact that they are published when unanimity was reached. Reports of the year 2006, and especially that of Feruary 2007 contain very depressing statements. The most importants ones are as follows (IPCC 2007):

- Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations

- The observed widespread warming of the atmosphere and ocean, together with ice mass loss, support the conclusion that it is extremely unlikely that global climate change of the past fifty years can be explained without external forcing, and very likely that it is not due to known natural causes alone.
- Anthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized.
- Both past and future anthropogenic carbon dioxide emissions will continue to contribute to warming and sea level rise for more than a millennium, due to the timescales required for removal of this gas from the atmosphere.

The expressions *very likely* and *extremely unlikely* have not yet been occured in the IPCC reports; they express a new stage of scientific conviction. A figure from the referred IPCC report demonstrates temperature variations in function of the world economy development. What does matter here is that even without any antropogenic green house gas emission surface temperature slightly increases, by 0,3 centigrade in this century. Warming up has already become „self-sustaining". Temperature increase due antropogenic emissions may vary from minimum 1 to maximum 6,5 centigrades.

We have started a natural process what we cannot stop anymore. Positve feedbacks emerge: with warming up ice cover is melting, the albedo of the Earth decreases, warming up further increases. The melting of permafrost also has begun which results in escaping to the air of an immensly big volume of methane from the frozen swamps. Its green house gas effect is many times more than that from antropogenic activity. With the slow warming up of the seas methane is also coming up from the organic residuals on the bottom of the seas.

What is at stake now is the measure of warming up. Scientists should like to stabilize temperature increase at 2 centigrade. Above that the damage of ecosystems becomes irreparable and warming up unhaltable. We must have in mind that average surface temperature during the ice age was only 5 centigrade lower. Let us imagine, what could happen with a similar change in the opposite direction. (And forecasts for the end of the century vary between 1,5 and 6,5 centigrade.)

The Stern Review on Climate Change (Stern 2006) in October 2006 revealed completely new facts concerning the costs and benefits of climate stabilization. Earlier, leading politicians and economists thought that mitigation should not have two much sense because there would be winners of the climate change as well and costs of avoidance should be extremely high in contrast to gains. The report proved that even Nordic countries would be losers after an initial gain and benefits of mitigation far overtake costs. Namely,while prevention should claim for roughly 1 per cent of World Gross Product yearly, in the lack of it 5 to 20 per cent of WGP would be lost in every year for ever. (For illustration: the costs of prevention of a

world epidemic should be roughly l per cent of WGP, or world wide advertisement costs make up the same amount.)

Observing the principle of auditur et altera pars, let us mention some opposing views[1]. These views are forming three groups: those which question the fact of climate change itself, others object to its antropogenic character (Hans Labohm, Fred Singer), and, thirdly, which do not deny the antropogenic climate change but not rank it as first priority for mankind. Björn Lomborg Danish environmentalist lately emphasises that the the envisaged costs of climate stabilization should be spent on supporting poor countries, combatting famine or AIDS in Eastern Africa (Lomborg 2007).

For many, like myself, James Lovelock is the author number one in climate affairs. He evaluates the possible consequences even more heavily than the Stern Review. While the latter says that consequences might equal as those of a world war, Lovelock adds that as a global nuclear war. According to him half a billion, but maximum one billion people could survive climate change by the end of our century. In an interview given by him to Rollingsotne.com, he explained that even if mitigation measures will have a high profile, the warming up could not be stopped (Goodell 2007). Earlier, Lovelock thought that the massive use of nuclear energy, replacing the fossils may save mankind but in this interview he saw no solution.

At last, the question of adaptation should be mentioned. As concerns nature and species, many think that it is possible, but the process of climate change will accelerate and all this will take place in such a short time, that genetic adaptation would be absolutely impossible. As concerns people and nations, the richest will have better chances to survive but the poor will vanish.

1.1. The theoretical framework of analysis[2]

We should examine whether economics and social sciences in their present form are apt to manage the problem. The climate change raises serious challanges in the following aspects:

- intra and intergenerational unequities,
- intertemporal unequities,
- regional and inter-national unequities,
- incertainties,
- risks.

The centrepiece of mainstream economics is welfare economics. Welfare economics is designed to be implemented within one country, supposing one

[1] This is based even if we only want to follow the criteria of science by Karl Popper (namely, it is scientific, what can be questioned).

[2] This point roughly follows the argument exposed in the Stern Review.

jurisdiction and one decision maker (government) and it is not apt to examine climate change, due to its global character. Its most important criterion is the social welfare function, meaning that welfare is maximal when the volume of goods and services sonsumed by households is maximum. The welfare function also can be interpreted only within one country, besides, it has a serious shortcoming from the point of view of the examined question. Namely, the social welfare function can be maximized at any (!) income distribution pattern. But implementing the social welfare function for the effects of climate change it would be unacceptable to defend mankind from the natural catastrophe in the way that only global effect matters, the differences in damages suffered by the single countries were neglected.

The ruling economic paradigm is equally unapt to manage uncertainties and risks. To the contrary, it is embedded in positivism, trying to quantify everithing, not taking account that economics is not a discipline without values. But analysing the effects of climate change, uncertainties and risks have an enormous importance. In most cases effects and damages to come can be fixed only within wide limits and given with a high coefficient of uncertainty.

The concepts which can bring us to our purpuse, to find the proper framework for the analysis, are externalities, public goods and free riding. It is because,

- the climate itself is a huge, global common good, the service of ecosystems,
- climate change is the world's biggest externality so far (never has been seen something similar),
- but climate stabilization policy is also a public good (as nobody could be excluded to enjoy its benefits),
- and free riding emerges with an all decisive weight: countries that make no effort will also enjoy the benefits of climate mitigation policies.

As a result, these concepts should be reinterpreted, implemented in global dimensions:

- The climate change as a global externality means that we should cover not only damages caused to others in our country and now, but we are responsible for damages caused in other countries and other continents, to other generations and in the future as well.
- Climate mitigation as global externality means that success can be achieved only by international co-operation, and the free-riders are the countries who do not participate in it. The international community has not any enforcing powers so far on the dissident countries and efforts will be fruitless while institutional solution will be born to include all the countries.

One of the many theoretical problems appears in the field of discounting. According to the well known method used in business calculations comparing and unifying costs and benefits accruing not in the same time are made through

discounting. Future benefits and/or expenses are expressed in present value with the help of discount rate and they can be compared this way. It seems to be evident that this method should be used in case of climate change as well, if we want to compare damages accruing in different places and times and costs and benefits of a climate stabilization policy which similarly appear in different times and places. But heavy methodological problems appear because the traditional discounting is apt only for comparing small scale differences by one trayectory, while in case of climate issues there are separate trayectories (countries, regions, affected by the climate change in a very different way) and separate time dimensions (present and future generations) and differences are huge.

All this is raising underlying moral and ethical problems: how to evaluate in the present damages caused unintentionally to other countries in the future; are we fully responsible or each country, each generation and each age should solve its own problem. The discount rate chosen depends on the moral answer given to this question. If it is high, it delivers a message that today's value of the damages accruing in the future is low, and as a result, it has not too much sense to make high sacrifice today to avoid it in the future and other places. And vice versa: if the discount rate is low, today's efforts should be increased to avoid big damages in the future.

Surveying the moral facade of our age we can state that consequentionalism, the background ethics of welfare economics has become the ruling orientation: it is the result, which does matter, the way through which it is achieved, is not important. The concept based on rights, truth and freedom, embracing the moral side of the processes as well (see at Amartya Sen), remains in minority. From the point of view of our topic the moral concept of sustainability and stewardship should rule that everybody should take into consideration the effects of decisions on others, the nature and future, this way enabling us to follow a successful climate stabilization policy.

1.2. International climate agreements

Climate stabilization can be pursued on international, regional, national and company levels, but individuals also can make a lot in favour. With a view on the above mentioned conditions, the most efficient instrument is the conclusion of international agreement. All we know the Kyoto Protocol and its shortcomings. If there is not a binding and general international agreement, which comprises all the important countries with high emissions, the phenomenon of free riding appears, the system is „leaking" and is inefficient[3]. Countries with obligation in the Kyoto

[3] To illustrate this: if Great Britain unilaterally stopped all its energy power plants from one day to the other, after 13 months world emission of CO_2 would be on the same level as before, because it would be eliminated by the growing emission of China. But if Great Britain ceased to emit any CO_2, it would take 2 years for the world to reach the same level by the same reasons.

process undertook a 5,2 per cent average reduction. And those with the biggest emissions did not subscribe it. According to a general position, held by all countries a 50-80 per cent reduction is needed by the middle of the centrury. As a result, the situation is very gloomy.

The mitigation measures may be of economic, administrative, technological or other character (e.g. an economic policy supporting local development vis-á-vis globalization; such a policy would yield in lower transport intensity and hence, lower CO2 emission).

Within the frames of an international agreement the best instrument for achieveing the mitigation targets would be the emission trading scheme. It can be realized both within the Kyoto Protocol and the EU has also created its own quota system. However, the international implementation is doomed, because there is no agreement, on what principle the qoutas should be distributed between the different states. (There are many principles, and each represent different interests which widely contrast. E.g., qoutas should be distributed proportianal to the former emissions, or the number of inhabitants or the energy intensity of GDP, etc.)

The main frontline is between the US and the emerging countries, headed by China and India. (By now, China has reached the total emission of America.) China and India rightly argue that their CO2 per capita emission is only a fraction of the US. (Namely, 3,3 and 1,1 tonne respectively, vis-á-vis the 23 tonne per capita of the US.)[4]. Besides, they emphasize the historical responsibility of the developed nations in forming the present situation[5]. In contrast to this, America argues that obligations should be equally shared. What has been achieved during the negotiations within the UN is the principle of shared but differentiated responsibility (although not equal). A special case is Poland, which, on the one hand, has huge coal deposits, on the other, due to historical reasons, it does not want to be depending on Russian oil and gas.

The all-decisive climate negotiations will take place in Kopenhagen, end of 2009. Many call it as the most important negotiation in history so far. Perspectives are a bit better as in the USA itself there is a definite progress towards climate protection. As concerns the US and West-European attitudes, the main difference is that while West Europe seems to consider possibilities in consumption reduction as well, the USA follows an active climate policy; it wants to defend climate by doing something, not by doing nothing (or less).

A new element in the mitigation policy is the suggestion to implement game theory in the climate discussions. A conclusion which underlines this is that climate agreements for long periods are not productive because countries which do not sign

[4] It should be mentioned that Malaysia, Indonesia and Brazil belong to the countries with highest emission, if land use is taken into consideration.

[5] USA is responsible for 29,3% of the total CO_2 emissions since 1850, the European Union for 26,9% and the G8 for two thirds. The respective figures for other countries are: China 8,3%, India 2,3%, Brazil 0,8%. See: Schwägerl, 2009.

the agreement become fixed in the position of free riders. In the spirit of game theories during the continuous negotiations the dissidents should be kept under permanent pressure and renegotiations may yield the result.

1.3. The energy sector and climate change

At last, some interrelations between energy and climate change should be highlighted. If scarecity was a real danger, environmentalists would have nothing to do just sitting and waiting how the market settles the problem. It should price fossil fuels according to scarecity and no enforcing measures should be needed. But this is not happening. New discoveries of large deposits make expected exploitation periods longer and longer. Besides, coal deposits seem to be enough for centuries, and the worst option for environmentalists would be, if China and India changed for coal, using it directly, without liquifying. Oil prices are sometimes soaring, but this is not a manifest of scarecity. (Take e.g. the two decades between 1980 and 2000, when oil prices gradually sank from 65 to 15 dollars, while the world permanently chatted about scarecity.)

However, the solution lies in price increase. Final consumption prices of energy and raw materials should be increased in each year in the same measure as the productivity of these resources improved in the previous year[6]. This could limit the increase of energy use and promote its productivity. A good example of the viability of the idea is pricing labour in welfare states: price and costs of labour gradually increased during decades, parallel with labour productivity. As a result, demand for labour decreased, and the case of structural unemployment appeared in the developed countries.

The frequent reference to low price elasticity of energy holds true only in the short run. In the long run the demand adjusts to prices, energy and fuel usage decreases, travel and transport habits change, demand for environmental friendly infrastructures increases.

Another basic problem is the production of renewable energies: whether they could replace fossil fuels and on what prices. Theoretically, renewables are undepletable and the only limit of their implementation is their price[7]. And their pricing depends on the actual price of oil and whether externalities caused by fossil fuels are internalized. And this brings us to the issue of social cost of carbon. From among the many calculations and variations let me refer to those I have herd recently in the concluding conference of the so called petrE research of the English-German Foundation (petrE 2009). To comply with the 20 per cent GHG reduction target up to 2020 in the European Union, a €53-68 per tonne of carbon price would be needed, but the 30 per cent reduction would necessitate a €180-200 price.

[6] This is an idea by Ulrich von Weizsäcker.

[7] In chapter 4. of this study I shall refer to the practical obstacles of the unlimited use of renewables.

We know the many (environmental and food market) problems of the biomass as well. As a result, the question seems to be more complex as it appeared at the beginning.

Investment bankers
may have nothing to gain
but their chains
(Karl Marx, inverted)

2. Financial and economic crisis

Alternative economists have been warning at least since 20 years that stock exchanges and international money markets are blowing ever increasing bubbles which are not covered by real values, bond and stock prices are artificially inflated and the bubbles can burst out at any time. Well, this happened.

The volume of derivatives grew to an uninmaginable huge sum, $596 trillion, which was only 142 billion in 2002. Gross World Product is a tiny sum compared to this, 54,3 trillion in 2007, only tenth part. Another base for comparison: total capitalization of firms on the New York stock exchange was $25.000 bn[8]. Warren Buffet, the richest investor of America calls derivatives as weapons of mass distructions. Besides derivatives, hedge funds also contributed to blowing the bubbles.

A substantial part of derivatives is made of CDSs (credit-default swaps). These instruments „allow investors to separate the risk of interest-rate movements from the risk that a borrower will not repay. For a premium, one party to a CDS can insure against default." The Economist rightly calls this financial „innovation" gambling on ruin. Since 2001 their volume grew above $60 trilllion[9]. Derivatives increased the weight of banks and financial institutions in an immense proportion; their share of the American stock market climbed from 5,2 per cent in 1980 to 23,5 per cent in 2007 and makes ¼ of all profits[10].

As concerns the concrete causes of the financial meltdown, securitisation of the mortgages played a key role in it. The big mortgage banks, to share risk, securitized loans, bundling them into packages and then sold them to outside investors. These investors got the monthly payments as interest payments on their bonds. Both sides gained: the mortgage bank could write the obligations off its balance and the investors got assets that yielded more than government bonds.

[8] Der Spiegel, 40/2008, p. 28. (In the original article: $596.000 milliard; in this paper I translate German milliard into English-American billion.)
[9] The Economist, October 18th 2008, p.76.
[10] I.e.

Besides, commercial banks could raise money by securitizing mortgages, instead of the slow, costly business of attracting retail deposits.

The driving force of the housing estate boom was the beleif that the real estate market will continuously enlarge, with increasing prices and occasional individual defaults do not endanger stable repay. But the decline in demand and mass bankruptcies lowered real estate prices and this triggered off a chain reaction of defaults in the money markets.

On 29 September the Dow Jones sank by 776,68 points, an unprecedented decline since its existing. The MSCI World Index fell 840 points between 29 August and 29 September. The total value of papers traded on the stock exchanges of the world devaluated by $10.900 bn in the four weeks preceding 10 October. In the Gulf states stock exchanges suffered a $158 bn loss. Many of the big financial institutions and banks went bankrupt[11].

And that was the beginning of the world's economic crisis. The financial losses were followed by a credit crunch and a mass loss of confidence. Credit squeeze resulted in consequences similar to heart attack in the economy: low demand, massive bankruptcies and high unemployment.

2.1. The visible hand takes over the rule

In the past decades, economics taught that a world crisis like that of 1929-32 could not happen again because national economies co-ordinate business cycles and international financial institutions guard over the safe of international finances. As the melt down began, governments of the leading countries started to help the economy and bail out the banks and financial institutions with an unprecedented haste: they have bought out the shares of banks in trouble, provided them with capital and credit sources, purchased their claims, raised state guarantees for small shareholders, etc. Central banks lowered interest rates to around 1 per cent in a quick and co-ordinated way. Still, the crisis burst out in its full scale with deep economic depression and high unemployment.

The situation is absurd. In the past three decades the ruling paradigm of economics, starting from the Anglo-Saxon countries[12], has been preaching the superiority of market above the state. It has attributed balancing and efficiency increasing character to the market in contrast to the low effficiency and perilous character of state intervention... And now, it is the scolded state, the visible hand that saves the market, tries to improve what went astray due to the market. What is even more, the state becomes owner of the banks that went bankrupt.

In the six months following the burst out of the crisis, $3000 bn has been allocated by the governments worldwide for stabilization and economic

[11] Der Spiegel, 42/1980, p. 114.

[12] Developed by Milton Friedman and the Chicago School and first implemented by Ronald Reagan in the United States and Margaret Thatcher in the UK.

stimulation[13]. To characterize this, the Nobel laureate Stiglitz coined the expression „American socialism", meaning socializing the losses and privatizing the profits. The American governement, besides the $700 bn stimulus package, assumed liability for the $5.400 bn mortgages of Fannie Mae and Freddie Mac and expended further $200 bn for taking under state control the two financial institutions.

On October 8 2008, to start credit flow, the leading central banks of the world took on an unprecedentedly quick, co-ordinated action: decreased interest rates. The Fed increased short term money supply to banks to $900 bn and began to buy the liabilities of commercial banks what never happened before.

2.2. Gambling and greed, or is this the nature of capitalism?

The first comments criticized greed and gambling, dominating the world of finances. Rightly done, as all derivative deals are based on which of the parties reckon better future events. It is natural, that Alan Greenspan, the main financial guru of the past decades also has been seriously criticised.

Greenspan presided the Fed for two decades (1987-2006) and not only accepted but openly encouraged those financial market developments and innovations which led to blowing of the bubbles and then to crush. He viewd derivatives as necessary instruments to spread risk. In 2000 he persuaded congressmen to deprive the Securities and Exchange Commission of its right to control the market of derivatives. In 2003 he instructed the Senate that a more severe control of these papers would be a mistake: „Nothing is in favour of that state control would be superior to the self-control of markets"[14]. His main political aim was to provide the American economy with abundant money, he realized the policy of cheap money supply. (In some years under his presidency the leading interest rate was 1-2-3 per cent.) Analysts mention as main causes of meltdown as follows:

- Deregulation and market liberalization: since the beginning of the '80s this was more than a ruling economic dogma; it was even intellectually fashionable.
- Cheap money, cheap credit: this was the official policy of Fed.
- Asian savings: the Asian (mainly Chinese) goods floded the American markets; this was made possible by the huge deficit of trade balance; beside this, the Asian savings appeared on the money markets.
- The culture of gambling (Stiglitz) and irresponsibility became general; they were supported by the financial innovations as „intellectual background"; the system was called „cowboy capitalism" as well (Fukuyama).
- The endeavour to spreading and sharing risk played a decisive role. Greenspan frequently argued with this. The problem is that even if risks are spread, their volume remains unchanged and it is still in the system.

[13] Der Spiegel, 43/2008, p. 29.
[14] Der Spiegel 42/2008, p. 28.

It is worth to consider the case from the point of view of the banking and financial sector. Their strive for independence is an evident motive; to be more than the mere financing agents of the real economy. Let us see, e.g., the background of securitization of real estate mortgages. The classical bank collects private savings by a tiresome work and uses them as backing credit loans. When the bank sold the securitized mortgages to the investor, freed its balance from a negative load and, at the same time, could get income. According to the 1988 Basel agreement, banks are obliged to form reserves for the case if their big borrowers go bankrupt. So it could be understood that they wanted to get rid of the negative items on their balance.

With the passing of time analysis appeared that searched for the basic rules and shortcomings of the system. „Each step on the long deregulatory road seemed wise at the time and was usually the answer to some flaw in the system" – The Economist explains[15]. In 1971 the gold-standard world economy was put an end. Since then, floating currences appeared and to avoid exchange rate risks, they were hedged by currency futures (first in the Chicago Stock Exchange). Today's complex derivatives are direct descendents of those early currency trades[16]. The abolishment of capital controls was a consequence of floating exchange rates. From the late '70s pension funds were allowed to act as institutional investors and began to roam over national borders. In 1999 the separation of commercial and investment banking was abolished. The SEC allowed for commercial banks and insurance institutions to trade in CDSs. These were the main steps on the long deregulatory road which led to the present situation.

A further system-specific cause was the social preference of conservative ideologies. Both Ronald Reagan and Margaret Thatcher favoured the nation of property owners, and on liberalised financial markets it was easier for homebuyers to get mortgages. The American Government backed the borrowing activity of Fannie Mae and Freddie Mac, what is more, in 1977 the US Congress passed the Community Reinvestment Act which disposed that banks should meet the credit needs of the „entire community".

And, at last, the digital techniques and the web created the possibility for the multiplication of financial deals.

2.3. Regulated capitalism or temporary taming?

Many of the critiques began to bury free market capitalism and forecasted a future with accentuated state intervention. However, the French model of state dirigism is not so successful as suggested by some politicians[17]. And what is embarrasing, the

[15] The Economist October 18th, 2008.

[16] It is not an accident that the Chicago School appeared in the vicinity of Chicago Mercantile Exchange.

[17] See e.g. The Economist, October 25th 2008. The state as owner. Re-bonjour, Monsieur Colbert.

political left, all over Europe, does not want to overthrow capitalism, despite economic decline and unemployment around 10 per cent. (What is more, in the 2009 European Parliament elections the Left has been defetead in most countries.)

Most leading economists and heads of international financial organisations emphasize the need of better international co-ordination, arguing that the world economy has become global, while management remained mainly in the competence of nation states. No doubt, this is right. As concerns mainstream thinking, a revitalisation of Keynesianism is spreading. But it does not seem probable that state intervention goes beyond the bailing outs and buying outs of the shares and liabilities of bankrupted banks and financial isntitutions. I am inclined to accept the above analysis of The Economist and a very similar analysis by the Newsweek[18] that the crisis stems from the very nature and logics of functioning of capitalism. Free market logics realy needed those steps on the long road of deregulation. But it should also be admitted that the principles of the Chicago School have frozen into dogmas and lived as intellectual fashion.

A ruling opinion seems to appear from the turmoil: since the Thatcherite revolution and Reaganomics the Western world has experienced a lasting upswing of almost 30 years. This ended with a deep recession, high unemployment and huge stimulus packages of taxpayer money. This is irritating because the bankers, whose greed was one of the causes of the meltdown, now are bailed out. However, all this seems to be a fair price for the past three decades.

My forecast is that of course, we shall have a period of accentuated state regulation, the visible hand may dominate for a while, as the confidence in the invisible hand has weakened. But if world economy was restaured and a new upswing began, we shall tread on the same or similar way as before. It is a misbelief that growth and stability were the normal state of the economy.The cyclical character of capitalist economy is unavoidable.

The most characteristic feature of capitalism is the permanent growth of productivity and supply. The problem lies in the lagging demand. In the 70's an originally thinking Hungarian economist, named Ferenc Jánossy illustrated this with the analogy of a well, which abundantly pours water without stop and cannot be closed (Jánossy 1975). (This stands for the ever-increasing productivity.) The main concern is to find the proper vessels to contain the water. I think, this will not be different in the future. The biggest problem will always be how to increase demand. To stop, choke down and retrain production are contrary to the very nature of capitalism. Hence, regulation and limits cannot have a longlasting role.

[18] Newsweek, October 13th, 2008.

3. Lessons from and conclusions of managing the two crises

The time scale. No doubt, this is the major difference. What happens here and now and with us, is more important than that with others, later and there. Economics calls this time-preference and to compare effects taking place later and in other places uses discounting, counts present value. A similar effect is expressed by the law of decreasing marginal benefit: the more we consume something, the less will be the use of the additionally consumed units.

It is our moral pattern, hidden behind these rules. The idleness and lameness against climate change is a moral issue. In contrast to this, the sudden reaction and activity to combat financial and economic crisis is not a moral issue; decision makers and leaders are not driven by the anxiety towards the fate of small people but they are concerned mostly of their own power and wealth. But in climate policy decisions not realized today do not mean a threat to their power and influence.

Natural and financial capitals. We have still not accostumed to attribute a financial value to natural capital. Notwithstanding that the life supporting services of natural eco-systems make possible our life on the earth. Ecological economists have already long calculated that only the value of the water-cleaning service of the oceans approaches the Gross World Product[19]. According to an actual calculation, the yearly loss in natural capital is 2-3 times higher than the total capital loss due to the financial meltdown (Black 2009).

Asymmetry of interests. Climate change will affect the poorest countries first of all, that are the less capable to protect against it. But the costs of climate stabilization today should charge, first of all, the richest countries (the biggest energy users) and the most powerful industries (energy, car manufacturing, chemicals, road building). The latter make an uncomparably srtonger coalition than the former ones.

Unlike climate change, the finacial crisis affects rather the most developed countries (where the centres of international banks and money markets are located), and the drying out of credits affects everybody. To avoid climate change it is the United States that should make the biggest sacrifices (change in lifestyles, modest housing conditions, less luxurious travels and energy use), therefore the US is the less interested in climate stabilization. In contrast to this, in combatting financial crisis the US is the most interested country, being the mostly concerned one[20].

State intervention. The comparison of the two crises serves as an interesting field for discussing on the character and necessity of state intervention. The standard welfare economics suggests state intervention in two cases: in case of market failure

[19] Evaporation – the formation of clouds – precipitation makes, as a matter of fact, a huge distillation system; this is how nature cleans the dirty water of rivers discharged to the seas and replaces it with clean water, delivered back to the continents.

[20] This held true for the beginning of the financial crisis. After, less developed countries were more affected.

or if politics wants to achieve an income redistribution. Market failure appears in case of monopoly, lack of information or externalities. Climate change is caused by global externalities! According to the theory, externalities should be internalized, namely, if they are negative, the casual agents must bear the damage caused. Due to intervention, the volume of polluting/damaging activity will reduce and social-economic optimum will be reached. All this will be the result of state intervention. Hence, according to the standard theory, to avoid climate change, state intervention is needed, but there is not enough of it.

And what grounds does economic theory give for state intervention in case of financial crisis? To qualify financial damage and loss as externality would be evidently a nonsense, as they emerged as a result of regular market operations, derivatives do have their markets (alas, what a big market!), unlikely the emission of green house gases (because if there were a market of GHG emissions, the emitter should pay the total cost and in that case sould not be there a climate change)[21]. Nor can we speak about monopolies, as the financial cruntch was caused by the cheap credits, available for everybody. And if we dared to be involved in a discussion about the income-redistributive functions of the financial and credit systems, we would be lost in the terminology of a neo-Marxist discussion[22]. The lack of information – in contrast to the previous items – is something to ponder. On the one hand, the digital techniques and informatics create such an abundance of information – especially in finances - , which is inconceivable for human brains. On the other hand, there must be still lack of information, otherwise the crises could not come, there would be foresight. This seems to be a paradox, but it is not difficult to answer it: the capitalism, originating from its nature, is still a system, operated by uncontrollable and unforeseenable market forces in the last instance[23].

As a result, in the case of financial crisis state intervention does not have the theoretical economic grounds, but it happens.

Institutions. The financial crisis has also a global character, like climate change, and the international financial network functions as a hydraulic system: may the pressure change at any point of the system, it can be felt at any other point[24]. Still, it is manageable because the proper international institutions do exist. But the international institutions which are inevitable for an effective climate policy, are missing. Their creation is mostly hindered by the United States which has a counter-

[21] When speaking about externalities, instead of using the regular criteria, it is more simple and suitable to refer to that of Samuelson: an external effect is what the market cannot manage.

[22] Probably there are not many, especially among the young people who know, how the classical Soviet political economy defined inflation: a process, during which incomes are redistributed through price increases in favour of the capitalists. (And this is true!)

[23] A question can be asked retrospectively: could the former socialist central planning be improved by the abundance of information delivered by IT of our age? The answer is probly no: the main deficiency of central planning was not the lack of information but the lack of proper material incentives for good management, technological development and labour productivity via high profits, wages and payments.

[24] An analogy by László Bogár.

interest in this. According to some experts, the lack of institutions can be replaced by the implementation of some elements of the game theory.

Does environmental crisis correlate with financial and economic crisis? Of course, the answer cannot be negative in the age of globalization. But the real question is whether does one of them aggravate the other, or how the solution of one helps the other.

It is evident that in time of economic recession resource use and pollution are less, but this could be considered as postponed demand, which will be satisfied during the coming take off. The question that really does matter is that how an acute, unmanageable and prolonged climate crisis does affect the economy and finances. This is the case we are having now. If environmental degradation will be further worsening, biodiversity suffering further damages, the life supporting capacity of the bioshere will further weakening. The apparent result of these processes will be the worsening of human health and decline in human production and activity. Let us refer again to the statements of the Stern review. In case of BAU 5-20 per cent of the Gross World Product will be lost, in every year, until the endless future. We cannot exlude that such a development could favour financial markets. Namely, one of the most important effects of climate change will be the immensely growing risks and uncertainties. (Financial markets have already acquired experience in implementing CDSs to share risks.) On the other hand, risks and uncertainties (due to increased and more frequent weather irregularities) will be reflected in the large volatility of exchange rates and prices.

But let us ask the other question too: How a successful and effective climate policy should affect the economy and the financial system? In practical terms, such a policy would mean the squeeze of the supply of energy and natural resources (or replacement of the fossil fuels with renewables). A switch off of the market mechanism is hailed only by biassed and badly informed environmentalists. The changed conditons could be imagined as a further limitation of the business sphere. In the welfare state public education and public health are out of the reach of the competitive sectors (and evidently, the traditional state adminsitration and services too). From that time on, part of the resource management and use of the environment will also be out of the competitive sector. (The share of this part is decided by the carrying capacity of the ecosystems.)

Rosa Luxemburg said at that time that the natural character of the capital is expansion. And when all the white spots will disappear on the world map, namely the expansion will be limited, something must be happened. And the first world war broke out. Wars, time by time unleashed by the Americans can be viewed as susch expansions, but this holds true for the enlargements of the European Union as well (which are by no means expressions of sympathy of the citizens of Northern and Western Europe towards the newly acceeding countries). (But the above mentioned analogy of water containing vessels by Jánossy also can be adopted to this situation.)

Theoretically there is a possibility for the capital to expand not in an extensive way (occupying new territories and resources), but increasing output from the same amount of inputs, developing technology and improving efficiency. But in this case it is the new consumer markets which are lacking... (Life is so complicated, but everything would be simple if the Say dogma was viable. Namely: that every production creates its market.)

The US objects to any element of a climate policy which involves in some way or another a kind of limitation (in resource use, pollution emission, consumption decrease). The Americans want to do something in favour of the climate and not not-doing: plant forests, improve resources efficiency by technological development, replace fossil fuels by renewables, etc[25].

In principle, the economy may develop dinamically even at stable or decreasing energy and resource supply[26]. But there are too many escapes. (Let us take the case of the new oil deposits to be exploited soon under the ice of the Nordic See; it is made possible by the climate change itself!) If scarecity occured in fossil fuels, with oil prices permanently increasing and costs of substitutes remained very high (including the different, environment frinedly uses of coal), it would be easy to take global climate stabilization measures. But amidst of energy abundancy it is practically impossible.

4. Is there a green way out of the crisis?

Soon after the financial crisis had broken out, a new idea appeared, how to save capitalism: the idea of Green Rescue, green energy revolution. UN Secretary General Ban Ki-moon called the cause „a green New Deal that would rebuild and reshape the economy of planet Earth in ways reminiscent of the programs that President Franklin Roosevelt used to revitalize the economy of the United States during the Great Depression" (Dickey–McNicoll 2008). The great political leaders of the world have taken up this cause: British Prime Minister Gordon Brown, French President Nicholas Sarkozy and – at that time presidential candidate – Barack Obama agreed with connecting the necessity of fighting climate change and combatting the economic crisis. Obama promised to invest strategically $150 bn over 10 years in a clean energy-economy, help the private sector to create 5 mn new green jobs, to manufacture plug-in hybrid cars, to invest in renewable energy projects, to enhance energy efficiency, to develop low-emission coal plants, next generation of bio-fuels, etc. The Japanese Prime Minister Taro Aso talked of „a great opportunity for new growth" and vowed that „we will achieve the low-carbon

[25] The production of biofuels is reaching very high levels in America. This was one of the reasons of the food crisis in the world economy at the beginning of 2008.

[26] This is the case, when the proper word to be used is „development". „Growth" should be used for an economy with increasing energy and resource supply.

society that is compatible with growth ahead of the rest of the world". According to MITI, the Japanese industrial ministry: building a new industrial infrastructure is needed by banking on more efficient use of energy and innovative technologies. Gordon Brown said that „…climate change should not move to the back burner of international concern…. I beleive the opposite is the case."[27].

Leaders of world organisations also declared their preference towards a green energy revolution and combining issues of energy, climate and economic crises. Robert B. Zoellick, President of the World Bank admitted that „It needs to interconnect energy and climate change."... „A new multilateralism is needed. It should reach beyond the traditional focus on finance and trade. Energy, climate change and stabilizing fragile and postconflict states are economic as well as political issues... A newly started $6 bn World Bank program on climate stabilization aims at completing UN negotiations with practical projects (technologies, forestation and adjustment)"[28]. „The solution needs a globally coordinated crisis management package, which aims at developing the new generation of low consumption and low exhaustion cars and creating green jobs" (Kemal Dervish Chief Administrator of UNDP) (Dervis 2009).

On the other side, no such ideas have been voiced by the most renowned economists, such as Stiglitz, Krugman, Summers or Phelps. Neither leading figures in international affairs, such as Pascal Lamy, James Wolfensohn, or George Soros made similar statements.

Huge energy saving projects have been started in the Western countries, with a special view on insulation of buildings,where most of the savings potential lies. These will result hundreds of thousands of new jobs. The most ambitious programme of all is that of President Sarkozy, launched in October 2007. The „Environmental Grenelle" consists of 268 recommendations, including 40% drop of CO2 emission from building heating by 2020, constructing 2000 km new TGV tracks by 2020, charging extra tax on fossile energies and offering tax credit on renewables, etc. In some respects Germany is the most progressive country in the EU, with a federal scheme to insulate the entire housing stock and an investment in wind power which puts the UK (with far greater wind resources) to shame (Monbiot 2008). Germany is specially well developed in the world market of green technologies.

A transformation in energy industry from fossils to renewables both could serve climate stabilization and giving new impetus to technological development that could overcome economic crisis. Historians of economics, such as Harold James of Princeton pointed out that each depression could be overcome by either a new wave of technologies or formation of new structures. The agricultural crisis in the 1840s was ended by the industrial revolution; the Great Depression in 1929-32 was followed by the development of services; the big boom of the end of last

[27] I.e.
[28] Newsweek, Special edition 2009.

century was a result of dotcom revolution; the last boom was due to the financial innovations in the housing estates sector[29].

Despite all this, the International Energy Agency is pessimistic. In recession consumption and energy prices go down and that discourages the development of alternatives. The development of alternative energy sources would require enormous amount of capital, with a distant payoff. Presently, with tight capital and credit and low oil prices private investors do not put billions in a distant clean energy future. At $140 oil prices alternative programmes pay off. At $70 development of alternatives make less sense, at below $40 not at all. Market volatility undermines long-term planning. According to the calculations of the IEA to reduce carbon-dioxide emissions 50% lower by 2050 requires investment of $45 trillion – now! Anyhow, if governments are funding for banks, why not for green industry, too (Dickey–McNicoll 2008)?

The US has a special interest in the green energy revolution. Michael T. Klare has published an article about the topic in the Special Edition of Newsweek under the title: „Time to Kill the Oil Beast". The heavy oil dependence of America might give an important impulse in the green overhaul of the world's energy industry, says the author. The US gets 40 percent of its total energy from petroleum and 23 percent from dirty coal. 60 percent of America's oil is obtained mostly from hostile countries. The US spends $50 bn a year in military costs on protecting its petroleum interests in the Middle East – yet it spends far less on trying to actively replace oil. Both this and a growing concern over global warming requires a large increase in reliance on reneable energy sources. Reducing oil's role as America's primary energy source (from 40 to 25 percent) and increasing the share obtained from renewables and hydropower to the same percentage (up from from 6 percent) by 2030 should be an ambitious goal (Klare 2009).

If we look at the character of the stabilization policies and packages of the leading countries, there are no signs of such a development: the overwhelming majority of the public money goes for the bailing out of banks, revitalizing the existing structures, promoting new car purchases with scrapping old ones and the development of green energy and industry is only marginal so far.

The British stabilization package is one of the world's least green, „Britain has allocated 7% of total spending to environmental causes, compared with 12% in America and 83% in South Korea."[30] But even the Chinese spent significantly more on the green cause. This is, why the Economist calls it a „Keynesian splurge". In absolute terms, China allocated $220 bn on low carbon investments, while America only $100 bn, Korea $31 bn and Germany $14 bn.

In July 2009, Green Alliance, a British NGO published a booklet under the title „From crisis to recovery – New economic policies for a low carbon future" (Hewett 2009). In the foreword its leading idea is formulated as follows: „The initial

[29] Figyelő, 2009. január 1-7.
[30] The Economist July 18th 2009.

step in response to the financial crisis, advocated by most governments around the world, and coordinated rather remarkably between nations, was a major public-spending stimulus... most if not all contained a 'green element'... But that phase is now over, and expecting the next wave of investment in green initiatives to come simply from the public purse is over-optimistic. The major investment drive for a low carbon economy must now come from the private sector..." The publication puts special emphasis on how to raise private money for greening the British economy and energy industry.

Earlier, I have surveyed the opinion of leading politicians and economists of the world concerning the green rescue. A special notice should be made to Angela Merkel, Chancellor of Germany. For many years, she had been a pioneer of green thinking and policies, a fervent agent of climate stabilization. However, with the break out of economic crisis, she followed an economic stabilization policy, pushing green considerations completely into the background. Germany has become the dirty man of Europe – writes George Monbiot in Guardian, evaluating the Poznan conference of the UN in December 2008: „It was Merkel who demanded weaker standards for fuel efficiency in cars, Merkel who pushed hardest for a €40 bn bail-out of the motor manufacturers, Merkel who now insists that the big cement, steel and chemicals companies are allowed to get away without paying" (Monbiot 2008).

What are the chances of the green rescue in the long run? Are the objectives of reducing green house gases 50-80 per cent by the middle of the century feasible? Nate Lewis of the California Institute of Technology made interesting scenarios for 2050. He supposed that world population will be 9 bn at that time, per capita world GDP increases on an average yearly 1,6 per cent and emissions should be decreased by 80 per cent. In case of a business as usual scenario present world energy use of 14 TW should grow to 45 TW. But with an unprecedented improvement in energy efficiency, 500 per cent relative to current US levels worldwide, world energy claim would be only 28 TW. To keep to the 450 ppm of emissions's concentration to be able to stabilize warming up at 2 centigrade, 26,5 TW of the 28 should be carbon free. So this is the task ahead of a green energy revolution, if consumption would not squeeze (Lewis 2004, Begley 2009).

One option is nuclear energy. If 10 TW of the 26,5 should be produced by nuclear, a new reactor should be built in every second day in the coming 40 years. „If you use every single breeze that blowes on land, you'll get 10 to 15 terawatts" (Begley 2009). But let us be realistic. 27 per cent of the land surface is good for producing wind energy. From the global potential, 4 per cent of the earth's surface could reasonably be used and that would provide 2 TW. To get 10 TW of solar energy by 2050, we would need to cover 1 million roofs with panels every day from now until then. As concerns biomass, its land requirement is even bigger. 20 TW by biomass needs 31% of total land area of the earth.[31] The main conclusion of Lewis is

[31] Lewis gives data concerning geothermical energies and carbon sequestration as well.

that „It's not true that all the technologies are available and we just need the political will to deploy them... we need Nobel caliber discoveries."

And as concerns my conclusion: maybe, there is no technologicl solution for the climate change. As a result: reducing energy use and consumption in general, becomes inevitable. And for that, the political decision would be extremely difficult.

The first angel blew his trumpet,
and there followed hail and fire, mixed with blood,
which fell on the earth; and a third of the earth
was burnt up, and a third of the trees were
burnt up, and all green grass was burnt up.
(Revelation 8)

5. Summary

The leading politicians of the world are aware of the dangers and risks to be brought about by climate change. However, solution is made almost impossible by the character of the problem: climate stabilization, as well as the climate itself, are global public goods. And as a rule, the phenomenon of free riding appears. Free riding can be managed in one country or in the frames of a regional integration, but not in international dimension, where enforcement is missing. This needs an institutional solution. Welfare economics does not provide an adequate frame to manage the issue because the social welfare function can only be interpreted with one jurisdiction and within one country. Nor discounting could be implemented in the long run and among different countries, and standard economics cannot manage risks and uncertainties to set in with climate change. Similarly, a very huge problem is the burden-sharing in climate mitigation, which raises responsibility for the past and the future, not to speak about divergent interests and different power relations. All this is caused by consequentionalism, the moral background of welfare economics and the consumer society. The solution supposes different ethics: the moral concept of sustainability and stewardship should rule that everybody should take into consideration the effects of decisions on others, the nature and the future, this way enabling us to follow a successful climate stabilization policy.

In contrast to this, financial and economic crisis can be managed within the ruling paradigm, with the existing institutions. True, there is a contradiction between the overall globalization of economic and financial processes on the one side and the overweight of nation states in economic decisions on the other, but the activity of international financial organizations can be improved. Business cycles could not be eliminated, they are part of the system, similar to greed and and the rush for profit. The beleif in the allmightiness of markets has been shocked and the visible hand of the state now plays an important role, but after stabilization economic liberalism will return. The general defeat of the political left in the elections to the European

Parliament at the beginning of this summer is a clear proof that people do not want a basic change in the ruling capitalist system.

An apparent solution would be to connect the two crises: giving a technological impetus and innovation to the stagnating economies by launching a green energy revolution, developing the renewables. No doubt, that would both help the economy and contribute to save the climate. However, thorough calculations underline, that the total energy demand of a business as usual extrapolation could not be satisfied with renewables and nuclear energy. The massive decrease of energy demand is inevitable. And it is difficult to imagine, how to achieve. As a result, unless basic scientific breakthroughs happen in energetics, our world could not be saved.

Financial and economic crises will set in time by time, they are unovidable, but they will be solved. Climate change will be only once, but it will not be avoided.

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The Social Role and Responsibility of Small and Medium-sized Enterprises – Results of an Empirical Investigation Applying the Social Capital Approach

György Málovics

An increasing number of projects deal with the social role and responsibilities of small and medium-sized enterprises (SMEs). The special literature on corporate social responsibility (CSR) and most projects determine social responsibility standards for SMEs based on the best practices of large companies. Thus they take the CSR activity of large companies as a benchmark for SMEs. This happens despite the fact that SMEs are structurally different from large companies to a high extent – and thus so is their potential regarding social responsibility.

In our study we analyze these differences and the way they influence SMEs' social responsibilities. Based on our literature review and the results of our qualitative results we conclude that the structural differences of SMEs from large companies should be considered in the relating empirical work and the social role and responsibilities of SMEs can be understood in the light of social capital theory.

Keywords: small and medium-sized enterprises, corporate social responsibility, social capital

1. Introduction

Even more projects deal with the social role and responsibilities of small and medium-sized enterprises (SMEs). The special literature on corporate social responsibility (CSR) and most projects determine social responsibility standards for SMEs based on the best practices of large companies. Thus they take the CSR activity of large companies as a benchmark for SMEs (Jenkins 2004, Jenkins 2006, Supino–Proto 2006).

This situation is problematic for at least three reasons. First, we have no empirical evidence that the CSR activity of large companies contributes to positive macro-level social or environmental processes (Banerjee 2008, Málovics et al 2008). Second, if we are to implement policies based on it there is a good chance that SMEs are not going to be able to meet the required standards because of their difference from large companies. Third, we may neglect positive social practices of SMEs because these are not to be found at large companies.

Thus in the first part of our study we briefly analyze the characteristics SMEs have compared to large companies. We also show how these influence the social responsibility of the sector. Since a relevant part of the modern special literature concludes that the social responsibility of SMEs may be understood in the light of social capital theory, in the second part of our study we analyze how SMEs relate to social capital. Afterwards we introduce the results of our Hungarian empirical work before we draw our conclusions.

2. The characteristics of SMEs' and its consequences on social responsibility

One of the structural characteristics which distinguishes SMEs from large companies is their *continuous financial difficulties* (Kállay–Imreh 2004, Vecsenyi 2003). Financial and liquidity problems are present on a daily basis at many SMEs. This is even true for SMEs which have otherwise no problems regarding their overall business performance (Béza et al 2007). According to one view, a consequence of these permanent financial problems and the lack of resources is that ethical aspects are less important for SMEs since they are fighting for survival on a daily basis (Fülöp–Szegedi 2006). Although this statement seems to be quite one-sided, many authors emphasize that SMEs are very sensible to the changes in the macroeconomic situation and so are their CSR activities (Vives 2006). A macroeconomic recession has a higher negative impact on SMEs – it may even endangers their survival – and thus the general state of the economy may influences their ethical activities to a high extent.

As long as CSR is basically a risk management tool for large companies, it is not true for SMEs. Most SMEs are not as much visible as large companies. They usually do not have their own brand and have no resources to plan risk management activities. Their primary goal is survival, so costly CSR activities rather enhance their risks than reduce them (Jenkins 2004). Since SMEs are not in the middle of media attention, there is a good chance that their do not look at CSR in the light of brand image and reputation (Jenkins 2006). There is also no empirical evidence that SMEs could attract better workforce or that CSR would contribute to the financial performance of SMEs – two reasons why large companies carry out CSR activities (Vives 2006). Therefore, it seems that even if strategic CSR is important for SMEs, it is probably not of critical importance. Thus other type of motivations (non-business ones) may occur for being responsible (e.g. enlightened self-interest, social consciousness and altruism) (Jenkins 2006, Vives 2006).

Access to economic resources may influence the introduction and adaptation of management systems to a high extent (Cambra-Fierro et al 2008). The lack of such resources often *does not allow the introduction of formal management systems and standards* (Jenkins 2004). The SME manager is furthermore often responsible for several business functions in the same time and thus has no consciousness

regarding issues not connected to the daily business activities (Jenkins 2006). In addition, the training of the manager may be insufficient to identify the implications of certain regulations or manage the necessary technology (Cambra-Fierro et al 2008, Csigéné Nagypál 2008). There is a good chance that SMEs' responsibilities will not at all (or only to a very limited extend) be formalized. It is an unrealistic requirement towards SMEs to have a written code of ethics or sustainability strategy. SMEs react on ethical dilemmas based on professional codes and norms rather than codes of ethics. Thus industrial norms, professional ethics, regulatory and moral obligations and their equilibration are behind ethical activities rather than standards and written documents (Vyakarnam et al 1997).

SMEs' social responsibility activities are not regular and usually not related to the enterprise strategy. They often do not even know that they are carrying out CSR activities (Szlávik et al 2006). The reasons for that are manifold: the high extent of (real or perceived) costs; lack of capacity (lack of time to identify stakeholders, lack of know and know who); certain attitudes (lack of knowledge of business benefits, fear of bureaucracy) and the present supply of CSR tools (basically applicable to multinationals).

The fact that ownership and management are often not separated, gives the chance to a certain level of autonomy (Jenkins 2006). Ethical action is thus influenced by a wide range of factors (Vyakarnam et al 1997, Cambra-Fierro et al 2008): the culture and values of the owner, certain personal characteristics, stakeholders (including the quality of stakeholder relationships), market forces, industrial norms, professional ethics, socio-cultural context and sectoral characteristics.

Lack of shareholders may result that SMEs are not necessarily under the pressure of short-term financial growth (as it is basically the case at multinationals). Thus they theoretically have the chance to carry out socially responsible activities like environmental protection or community involvement (Jenkinks 2004) and this characteristic theoretically opens the space for personal convictions and moral decision-making (Fuller–Tian 2006). Thus the profit maximizing criteria is not necessarily characteristic to SMEs. They can follow other goals like producing products considered useful by the owner-manager, community support, helping certain community members in disadvantageous situation. This does not mean that SMEs are not interested in making profits. It only means that their goal may be satisfactory profits instead of profit-maximization (Vives 2006). On the other hand there is no necessity for them to reduce their payoffs with CSR as long as they provide a satisfactory standard of living for their owners, since the main goal of 60% of SMEs is survival (Jenkins 2006).

Because of the embedded nature of SMEs employees and local community have an outstanding importance among the stakeholders. Thus SMEs potentially contribute to the development of the local community to a large extent. SMEs are

naturally local institutions, their owner-manager, employees and customers are the members of the same community. Most of the employees personally know the owner-manager who thus has more information regarding the well-being of the employees and may be more committed towards it (Matolay et al 2007). Based on this it seems logical to assume that these enterprises are committed towards the local community and local environmental and social issues. But there are also factors which cause that they are not as involved as one would accept. These are basically the lack of resources and knowledge and the fear of regulation (Vives 2006). SMEs also often operate at peripheries, detached from the local community. Furthermore, the dominant stakeholder for many SMEs is often one, large customer company, to which the SME is financially tied. The reliance on one large customer may push SMEs to adopt voluntary standards such as the environmental standard and SMEs may be obliged to address CSR (Jenkins 2004). On the other hand such mandatory responsibilities based on standards do not necessarily works towards real locally responsible behavior or even works in the opposite direction by the reduction in the number of local stakeholders. Thus, while according to some SMEs play an important role in local and regional development there are many who states that they are detached from local (economic) initiatives (Spence–Schmidpeter 2003). According to the empirical data (Spence–Schmidpeter 2003, Szlávik et al 2006, Observatory of European SMEs 2002, Jenkins 2006, CERFE 2001) SMEs' involvement regarding local environmental and social issues is definitely more significant than it is in the case of national and international issues.

To conclude, we may say that the social responsibilities of SMEs differ to a high extent from those of large companies (Cambra-Fierro et al 2008). Based on these differences we can not state that company size determines the level of social responsibilities to one direction or the other. But we can clearly state that there is a good chance that there are real differences (Table 1).

Because of the aforementioned characteristics it is not possible to understand SMEs' social role and responsibilities by simply searching for CSR methods applied by multinationals. According to one approach, the notion of social capital offers a proper frame to understand the societal role of SMEs. Mainstream CSR and business ethics concepts – e.g. triple bottom line or balanced scorecard – are not applicable to SMEs since all of these are bureaucratic methods demanding administrative structures, professional implementation and well-paid experts (Spence et al 2003). Therefore, it is not enough to simply broaden present approaches but we need a totally new approach in order to understand the relationship of SMEs to CSR. The notion of social capital offers new perspectives and research methods since there is a good chance that its embedded and interactive nature is relevant from the aspect of SME responsibility.

2.1 The social capital and its positive and negative effects

Social capital is an interdisciplinary (Woolclock–Narayan 2000) "umbrella concept" (Adler–Kwon 2002, p. 18.), since it includes a wide range of notions e.g. informal alignments, trust, culture, embeddedness, social and inter-organizational networks (Csizmadia 2003). According to one categorization SC definitions have two groups. One identifies social capital with certain components of social structure (horizontal and vertical relationships, power relations, governmental system and formalized institutions) while the other one identifies it with beliefs and behavioral dispositions (norms of cooperation, trust). Most approaches of social capital do not fit unambiguously into one of the aforementioned groups but contain elements from both of them (Kopasz 2005). Thus a common feature of modern social capital frameworks is that they define social capital by structural (networks, social ties) and cultural (trust, norms, values) characteristics.

Table 1. Divergence in CSR theory for large and small organizations

	Corporate CSR	**Small Business CSR**
Who	Responsible to wide range of stakeholders	Responsible to fewer and/or different stakeholders
	Perceived responsibility to society at large	Perceived responsibility to the local community
	Importance of shareholders	SMEs often don't have stakeholders
Why	Protection of brand image and raputation	Protection of customer business
	Pressure from consumers	Pressure from business customers down the supply chain
	Shareholders pressure, the SRI movement	Pressure from money lenders? Unaffected by SRI movement
	The business case	Proven business case lacking
How	Based on 'corporate values'	Based on principles of 'owner-manager'
	Formal strategic planning for CSR	Informally planned CSR strategies
	Emphasis on standards and indices	Emphasis on intuition and ad hoc processes
	Key involvement for CSR professionals	No dedicated personnel for CSR programmes
	Mitigation of risk	Avoidance of risk
What	Prominent campaigns e.g. Cause Related Marketing	Small scale activities such as sponsorship of local football team
	Publicity linked to CSR activities	Activities often unrecognised as CSR related

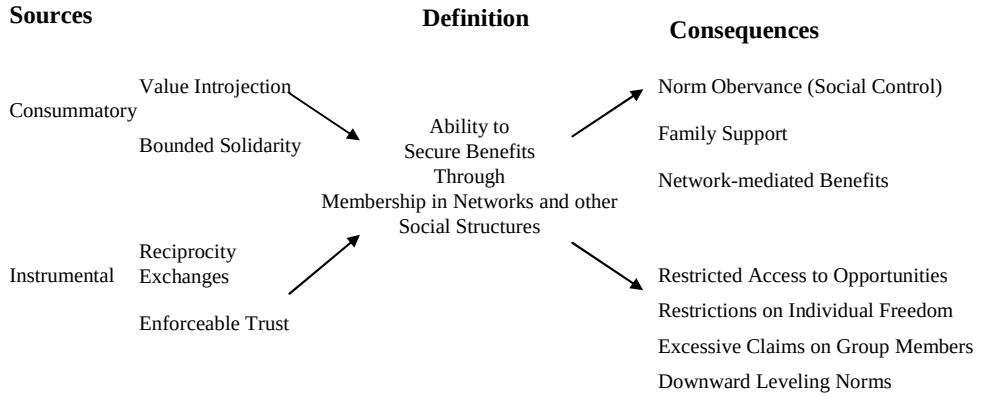
Source: Jenkins (2004, p. 51.)

The basic idea behind social capital is that communities disposing of a divers stock of non-governmental organizations and social networks are in a favorable position in fighting poverty and vulnerability, handling conflictual situations and taking advantage of new opportunities (Woolclock–Narayan 2000, Woolclock 2001). *Social capital provides informational, power and solidarity advantages for its owners.* Furthermore, social capital helps collective action (Adler-Kwon 2002)

since it enhances the costs of opportunism and helps the emergence of trust, altruism and cooperation (Kopasz 2005).

On the other hand social capital also has its risks (Adler–Kwon 2002). The high level of a focal actor or group may result in negative externalities for the whole group itself. The informational advantage of focal actors may lead to tragedy of the commons. Furthermore, minority actions aimed at the enhancement of minority influence may lead to a suboptimum at the level of the community. Social capital may thus lead to nepotism, injustice and corruption – the exclusion of actors having no (or low level of) social capital (Woolclock–Narayan 2000). This is the so called negative social capital (Portes 1998) (Figure 1).

Figure 1. Actual and potential gains and losses in transactions mediated by social capital



Source: Portes (1998, p. 8.)

Therefore the high level of social capital is potentially of significant social and environmental relevance. On the other hand social capital is a quite complex notion which is very hard to test empirically – especially in connection with social responsibility.

2.2. SMEs and social capital

The social role of SMEs is nowadays even more seen in the light of their contribution to social capital and thus the common good (Spence–Schmidpeter 2003). The conclusion of the relating special literature is that SMEs are involved in a wide range of socially and ethically conscious actions but this simply can not be measured in the same way as the CSR of large companies (Spence et al 2003).

Since the social capital approach is an embedded one, it places the economic actor in its social environment. Thus business ethics and social responsibility does not operate in a vacuum, independent of the other parts of the world but rather in a

social context. “Social capital is an interactive concept. Small and medium-sized firms are not >microcosms< that could be conceptualized as a >hermetic world< with its own rules and laws. Rather they exist predominantly because of a constant and essential exchange with their economic and social environment. This is true even where SMEs are considered to be disconnected from their local settings. Still, economic, physical and social ties, we argue, can be important.” (Spence et al 2003, p. 19.). “In addition, the social relationships and networks in which these owner managers are entwined cannot be separated from the business.” (Spence–Rutherford 2003, p. 2.). Thus businesses can not be handled as separated units motivated by making profit alone, but rather in the light of their complex social relations which often appear as social capital.

SMEs’ motivations to invest in social capital may be manifold (Spence et al 2003). Such motivations are the stabilization of mutual expectations and enabling collective action (trust), to form a kind of insurance and to have access to relevant information.

Spence and Schmidpeter (2003) found the *following factors regarding SMEs’ contribution to social capital:*

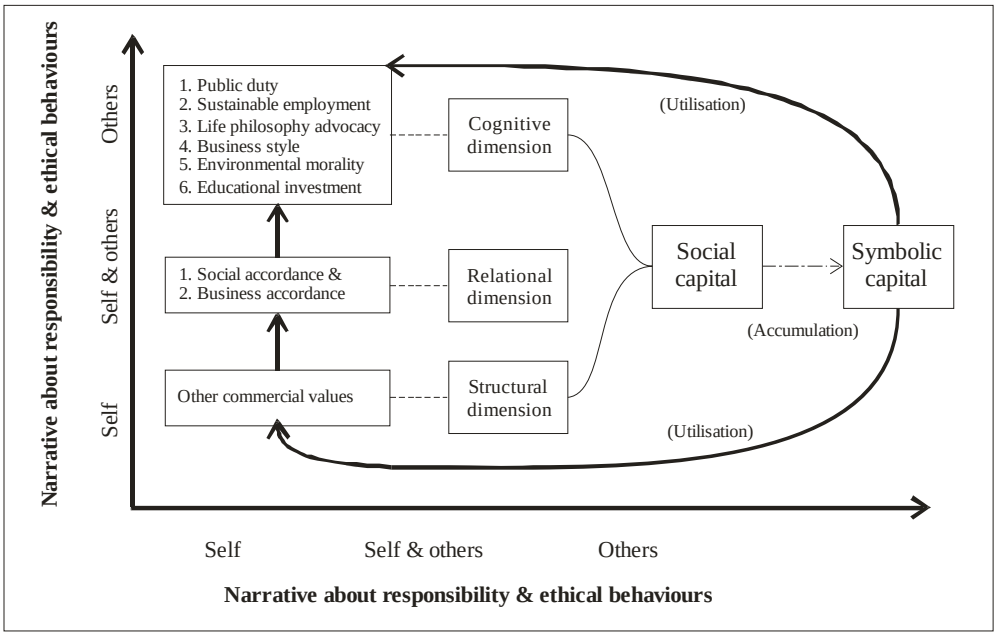
- SMEs’ social involvement is influenced by sectoral differences.
- The engagement of owner-managers is not always business-orientated. Local involvement often offers them a change of focus and a different challenge. This has no positive effect on business performance in most cases – so the profit motive is not the main reason for involvement. CSR usually does not result in a win-win situation. Owner-managers are often motivated by ethical and social aspects.
- The major restriction to engagement is time and perceived opportunity for engagement.
- A significant element of SME CSR is small favors for the employees and neighboring enterprises.
- SMEs are not really involved on a national or international level where they feel to be pretty much dependent on politics.
- Informal networks play a very important role for SMEs by giving access to information.

According to another research (Spence et al 2003) *there are many forms of social capital which are relevant from the aspect of SMEs’ social responsibility.* Such are informal and formal business relationships, networking within sectors (including exchange of information, borrowing of equipment, recommendation and subcontracting), networking across sectors (where geographical proximity plays a crucial role) and classic tools of responsibility like voluntary activities and charity (sponsoring local art and local health care, often done by the companion of the owner-manager). Regarding the motivations for such involvement and contributions to social capital the authors found several reasons: some invoked notions of

community and a feeling of wanting to "give something back", others considered that they were simply the right or wrong personality type, and again others identified the benefits which came from engagement, which emerge over the long term.

Fuller and Tian (2006) aimed to understand SMEs' social role and responsibilities based on the assumption that social capital is indeed a resource for SMEs and thus has an instrumental characteristic for them. They define symbolic capital „through its function of mediating power through prestige, and can consist of economic, social or cultural capital." (Fuller–Tian 2006, p. 291.). The symbolic capital of SMEs emerges based on the personal values of the owner and through the key stakeholders and may contribute to their economic capital. Thus ethical behavior may provide business benefits (e.g. opening up new markets) through contributing to symbolic capital (creditability).

Figure 2. Social capital concepts, orientations of responsible entrepreneurship and the interchange of capital in the narratives of small businesses



Source: Fuller–Tian (2006, p. 294.)

Based on Nahapiet and Ghoshal (1998) there are *three types (or dimensions) of social capital: structural, cognitive and relational dimension.* The structural dimension of social capital refers to the overall pattern of connections between the different actors. That type of social capital means a valuable source of information benefits. The cognitive dimension of social capital refers to those resources which provide shared representations, interpretations and systems of meaning among

parties. This type of capital allows the exchange and combination of knowledge and enables people to create common ground which facilitates future cooperation and information exchange. On the other hand the cognitive dimension of social capital „implies a requirement on the agent to share responsibility and resources with partners or stakeholders in their networks." (Fuller–Tian 2006, p. 290.). The relational dimension of social capital refers to the personal relationships people have developed through a history of interaction. Increased relational social capital can to a large extent contribute to the opportunities of an enterprise by enabling to access more informational, physical and emotional support in the business process.

Based on these three dimensions of social capital there are three different motivations regarding SMEs' contribution to social capital. The motivation connected to the structural dimension is value. SMEs provide value for stakeholders (first of all customers) by which their motivations are mutuality, trade and business value and advantages. Regarding the relational dimension their motivations are social expectations – contributing to basic charity actions, paying bills on time, not being corrupt and helping other enterprises. These refer to the strategies aiming to create trust and cooperation by meeting the expectations of the society and business. Motivations regarding the cognitive dimensions (e.g. creating the balance of work time and free time, enhancing happiness) are beyond any type of expectations and refer to normative motives (Figure 2).

Contribution to social capital is thus not mere altruism but often serves self-interest because of the instrumental character of social capital. On the other hand SMEs need to meet local expectations because of their embedded nature. Otherwise they loose they symbolic capital and thus their license to operate especially since the owner-manager personally can not be detached from the enterprise in the eye of the stakeholders. Thus the embeddedness of the owner manager in the local community means a social regulator for SMEs (Fuller–Tian 2006).

3. The results of the empirical research

Based on the aforementioned results of the special literature *our research aim was to explore the characteristics of SME social responsibilities and to examine weather the concept of social capital is appropriate to understand the social role of SMEs.* We formed the following hypothesis in connection with our research aim:

- *Hypothesis 1*. The concept of social capital provides an appropriate framework for understanding the social responsibility of SMEs. SMEs contribute to social capital in many ways (involvement in local environmental and social issues, supporting local NGOs, providing voluntary work in order to reach local environmental and social goals, providing small favors for the employees and contributing to networking within and across sectors).

- *Hypothesis 2.* SMEs' social activities and stakeholder relations are informal. Instead of formal relations and arrangements SMEs emphasize local and industrial norms, ethics, values and laws.

3.1. Research methodology

Because of the relatively "under-researched" nature of the topic (Spence–Schmidpeter 2003) we applied qualitative methods. The application of such a research method was also important since empirical evidences show that SMEs' social responsibility (as a result of SMEs embedded nature) is to a high extent influenced by the local environment (Spence et al 2003). Thus, although we find aspects in the international special literature to guide Hungarian empirical research, a preliminary exploratory research phase seems necessary before beginning with any quantification.

We conducted 9 in-depth semi-structured interviews during July and August in 2008 (we mark our interviews from V1 to V9 when introducing our results). Our research population was the ISO 14001 qualified SMEs of the South Great Plain Region of Hungary. We decided beside this population because it can be considered as the leading companies of the given region in the field of environmental protection. We developed the structure of our interviews based on Matolay et al (2007).

We consider it important to emphasize that the aim of our research stayed hidden in front of the interviewed through the whole interviewing process. This was necessary because CSR is a sensible topic surrounded by significant social expectations. In such cases using an indirect research method is important in order not to reveal "greener" or more socially conscious entrepreneur preferences through the research process than the real ones.

3.2. Research results

Accordingly, our research aim was to explore the characteristics of SME social responsibilities and to examine weather the concept of social capital is appropriate to understand the social role of SMEs.

Regarding our first hypothesis, in connection with involvement in local environmental and social issues and supporting local NGOs we found that the interviewed organizations consider it very important to minimize the negative local environmental effects of their operations (V1, V5, V6, V7, V8, V9). This can be seen as a form of enhancing eco-efficiency). But these results may stem from our research population since all of its members are ISO 14001 qualified - a standard aiming to reduce the negative effects of the given firm's operations.

Three enterprises stated that they do aim to *preserve certain local environmental assets through their activities*. These assets were water (V1), clean landscapes (V6) and the general natural environment through proper waste treatment

(V8). Several SMEs are involved in local environmental and social issues, generally in strong connection with their own activity. Such involvements are the subsidy of a local TV station and producing TV programs (V1), enhancing environmental consciousness and environmental education in schools (V1, V8), foundation and operation of an environmental NGO (V8), supporting schools by securing opportunities for the otherwise missing vocational training (V3, V4, V5) and providing material support and free or preferential services (e.g. repairs) for schools and kindergartens (V7). Involvement independent from the core activity is a lot rarer. However, examples for that are the support of local sport clubs (V4, V5), schools (V4) and health institutions (V6).

We found *several examples for networking within sector*. The forms of such networking activity are: mutual recommendations for work in case of lack of capacity (V1), the combination of sub-contractor and competitor relationships (V4, V6, V7, V8) and long-term business (supplier or customer) relationships (V1, V2, V3, V7, V9). On the other hand we only found one example for networking across sectors (V7).

We also found examples of small favors – another element of social capital (Bodorkós–Kelemen 2007). These exist first of all in the relation of employees. Their most common form is financial help (V1, V2, V7) but we also find examples of helping employees having problems in their private life (e.g. family problems) (V1, V2), securing flexible work-time (V2), education (V7) and tommy (V8).

We also found examples of *formal business or work relationships being transformed into informal relationships*. Such sign is the co called homely relations of employees and the manager (V1, V2, V3, V5, V6). Almost all of the interviewed emphasized that their employees can ask them (the managers) for help in case of any personal problems (e.g. children being in a bad company, divorce, administration). Common programs organized for the employees also contribute to the strengthening of informal relationships (V2, V5, V6, V9). These are "brigade dinners", collective outdoor cooking, sport days and family days. Similar programs are also organized for business partners in several cases (V4, V6, V8, V9). More interviewed emphasized that these events help the emergence of consolidated, correct competitor relationships and trust which are essential in certain industries.

> *"Our relationship with the suppliers is trustful. This is necessary since we are the ones who weight for them. Trust enables them to accept our weighting. There is a "friendly-business" relationship which guarantees accuracy. This works back and forth and acknowledges itself on the long run." V2*

Thus *our first hypothesis is confirmed* since most categories of social capital (networks, local involvement, small favors and informal relationships) are relevant from the aspect of SMEs activities. In addition, SMEs contribute to social capital in

many ways (local involvement, supporting local NGOs, small favors for employees and networking within and across sectors).

In connection with our *second hypothesis* the interviewed basically *did not mention any formal tools or relations* regarding social involvement and responsibility. However, we found that they perceive certain *norms and values* as mutual expectations in their stakeholder relationships. In reference to employees these are trust (V1), security (V1, V2, V4, V5, V7, V9), reliability (V2), honesty (V3) and fairness (V3). In reference to business partners the interviewed mentioned computability (V1), trust (V2, V5), fairness (V3, V6, V9) and honesty (V5, V7) as mutual expectations.

> *"expectations are accuracy, fairness, working on time and precise, reliable work" V3*

We found similar values in connection with entrepreneur credo.

> *„…computability, accuracy, honesty and if it has a result than it is good." V1*

We only found one enterprise (V6) which emphasized that they have a code of ethics (formal instrument) to guide the actions of their employees.

We also found evidence that *industrial norms are relevant regarding ethical behavior.* Many SMEs mentioned that one of the main obstructive factors regarding ethical and legal operation are competitors engaged in illegal employment and dumping pricing (V1, V2, V4, V5, V6, V8). Therefore the interviewed attribute high relevance to state regulations and the establishment of even conditions of competition.

> *„Ethical behavior is hindered by the unethical behavior of others. In such cases the equilibrium of competition is kipped. This is not obvious but one can guess it. E.g. if someone takes a job under procurement costs than it is dubious. One can not go for sure, since it is possible that they are well stocked but it is still dubious." V5*

Tilley (2000) found the same through her empirical investigations. According to these SME managers do not support self regulation in environmental issues. The reason for that is their opinion of the economic structure rewarding selfishness instead of rewarding contributions to collective interests. Therefore, environmentally friendly activities work against competitiveness. There is a significant tension between environmental and economic responsibility within the present economic structure. This does not mean that SME managers do not care about the environment. It only implies that in case of such tensions economic concerns are

more important than environmental ones since the economic system and the business climate are dominant forces acting against voluntary involvement. Thus self-regulation encourages opportunistic behavior.

We also found *significant tensions between legal regulations and local/industrial norms* (see also Matolay 2007). Thus industrial norms, habits and economic characteristics determine the opportunities for legal or ethic behavior to a large extent.

> *„Getting work for the company is a continuous task. It requires the best decisions. You have to compete for the job and find the job. A firm which is ethical today bankrupts. One has to be a bit evil and shameless in order to be effective. I like football so here is an example. Elbowing became normal in football nowadays. Rules allow it. If you do not accept that you can play like that because rules are deformed, you are going to loose." V4*

Furthermore, based on the aforementioned, Many SMEs *equate legal operations* (e.g. legal employment) *with ethical behavior* (V1, V4, V5, V6, V8, V9).

> *„Black work (illegal employment) is present in Hungary because there are costs and revenues, bur revenues are fixed, prices are >depressed<, and thus black work becomes natural. We do not apply black work because the owner opposes it, despite the fact that black money attracts workforce because of the higher wages." V4*

Not only industrial norms are the ones which determine the interpretations of and opportunities for ethical behavior but also the economic and other characteristics of industries. Regarding economic characteristics: SMEs which are involved in mutual debit feel a strong pressure to reduce costs at each area including the area of social responsibility. In connection with other industry characteristics: in the case of industries working with hazardous materials a certain minimum level of responsibility (the protection of human health) can not be questioned.

> *„In our profession there can be no limits to taking responsibilities since people can die because of the chemicals. We always have to carry out everything very consciously. The responsibility is enormous." V7*

Thus *our second hypothesis is also confirmed* since SMEs social activities and stakeholder relations are rather informal. We found no signs of formal instruments – except of one mention of a code of ethics. On the other hand local and industrial norms, ethics, values and laws are quite important regarding SMEs' self perceptions of ethical and unethical behavior.

4. Summary

SMEs – although being quite heterogeneous – have significant structural differences compared to large companies. These determine their social role and responsibilities to a large extent. Regarding this role and these responsibilities the notion of social capital is of high relevance. The reasons for that are that on one hand it is applicable to helping the understanding of SME's social role, on the other hand SMEs main responsibilities come from their contribution to social capital.

Based on the special literature and our Hungarian empirical research we can say that social capital provides a proper frame in understanding the social responsibilities of SMEs. Hungarian SMEs contribute to social capital in many ways – e.g. involvement in local environmental and social issues, supporting local NGOs, volunteering for local environmental and social goals, providing small favors and contributing to networking within and across sectors. Furthermore, SMEs' stakeholder relationships and social responsibility are of an informal character. Local and industrial norms, ethics, values and laws play a central role in the self perception of SMEs regarding their social responsibility instead of formal relations and arrangements.

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Is Their Consumption Sustainable? An Inquiry into the Consumption Habits of Citizens and University Students of Szeged

Mónika Tóth

The unsustainability and the potentially self-destructive character of the current socioeconomic processes have become a problem to be considered by public opinion and the researchers of environmental issues. The paradigm of sustainability emphasizes importance of the ecosystem that generally apprehends in economics through the notion of natural capital. It is a scientific fact that these processes can restrict the socioeconomic options in the near future by irreversibly ruining certain unsubstitutable ecosystem services. Since the publication of the Stern Review these facts have also been recognized in economics. Regarding these tendencies, even more authors emphasize that it is necessary to reduce the environmental effects of the personal consumption of the citizens in developed countries, including Hungary.

In the first part of my study, I examine whether the ecological footprint is an appropriate measure for environment-conscious consumer behaviour. I conclude that it can be an important tool since it measures the real environmental effects of consumer behaviour. There are several criticisms regarding EF because the measure has some weaknesses, but presently there is no tool for sustainability which is complete and none will satisfy everyone perfectly. The size of the ecological footprint is in connection with the following factors: population, consumption per capita and technological efficiency. From these factors the individuals can have an effect on their own consumption. Therefore, in my study I investigate what influences the environment-conscious consumer behaviour of the inhabitants of Szeged based on my former research.

Keywords: sustainability, sustainable consumption, ecological footprint, Value-Belief-Norm Theory (VBN Theory)

1. Introduction

The concept of sustainable development has become an integral part of current political and scientific discourse. Nowadays the unsustainability of our social-economic system has been reinforced by influential documents (IPCC 2007, Stern 2006). The *paradigm of sustainability* emphasizes importance of the ecosystem that generally apprehends in economics through the notion of natural

capital[1] (Ekins et al 2003, Gutés 1996). Nature provides vital ecosystem-services for the economy through ecological processes supported by biodiversity (Ekins et al 2003). Humanity damages biodiversity and ecosystem-process, therefore *human transformation of the biosphere* (Takács-Sánta 2004) is becoming a severe problem from the aspect of future consumption possibilities and life circumstances (Stern 2006). Thus, the restraint of human effect on biosphere is essential for sustainability. Consequently, examination of the effects of consumption and the chances for reducing consumption is an essential field of study. It is important to examine which factors influence consumption and consumer behaviour.

Neoclassical economics, considered as the mainstream paradigm of economics, assumes that resources (thus the natural capital) can be divided and available infinitely, which assumption does not hold its own since changes in natural capital are often irreversible (Norgaard 1995). Neoclassical economics treats nature as a subsystem of economy, however, this question should be viewed quite the contrary, that is defining economy as a subsystem of nature since human economy cannot be imagined without the services of the natural capital. Thus I agree with the latter approach – the economic system embedded in nature. Literature differentiates between weak and strong sustainability. Supporters of *weak sustainability* consider artificial and natural capital replaceable with each other. According to this opinion the stock, that is the joint value of the natural and artificial capital, cannot decrease. In the case of *strong sustainability* one of the main criteria is that the natural capital should remain on a certain level, irrespectively of the artificial capital. Thus the natural and artificial capitals are not perfect substitutes. So the three keystones of sustainability – economy, society and environment– cannot be substituted for each other, but they are interwoven.

Hereafter, from the differentiated strong and weak sustainability I consider the former and the approaches of ecological economics as determining. In the following part I present the ecological footprint, a tool which can help transfer the above mentioned strong sustainability to planning.

2. Background and methods

In my study, I investigate what influences the environment-conscious consumer behaviour of the inhabitants of Szeged. I use the ecological footprint (EF) measure which can be an important tool since it measures the real environmental effects – and not only environmental intentions – of consumer behaviour. *The ecological footprint measures humanity's demand on the biosphere in terms of the area of biologically productive land and sea required to provide the resources we use and to absorb our waste* (in global hectare – gha) (WWF 2006). According to the data

[1] Natural capital is defined as the stock of environmentally provided assets, which provide a flow of useful goods and services (renewable, non-renewable and generally non-replaceable) (Goodland 1995).

of 2006, an "ordinary citizen" has an EF of 1,8 gha. But we can also find huge differences. The EF of Western countries is extremely high, within this category, the North-Americans have 9,4 gha and the Canadians have 7,6 gha of EF. These are followed by the East-European countries, the Hungarian citizens' average ecological footprint is 3,7 gha. It is worth noting that nowadays the ecological footprint of humanity exceeds the biocapacity of the Earth (1,8 gha) with 25 % (this is the so called global ecological deficit). *This means that humanity's demand on the biosphere exceeds the carrying capacity of the biosphere* (WWF 2006). For this reason, the ecological footprint of humanity has to be reduced below the present world-average. According to present estimations, *by 2050, an overshoot of 200%* will be reached if humans do not change their lifestyles and initiate new, environment-friendly technologies.

The size of the ecological footprint is in connection with the following factors: *population, consumption per capita and technological efficiency*. The ecological footprint calculation is a multiple-stage process and the indicator can be determined with a simple formula (Ekins 2004):

$$I = P \bullet C \bullet T$$

where I is Impact, P is Population, C is consumption per capita and T is technology, which is used for consumption and production. The ecological footprint is similar to the formula which illustrates the humans' effect on the environment, whereby the scale of humans' biosphere-transforming activity depends on three factors, which are in close connection: population number (P), consumption per capita (C – GDP per capita), and environmental effect of consumption unit (T – environmental effect). The latter is the technological component (T) in the EF, because production technology determines the environmental effects of a given scale of consumption to a great extent.

There are several criticisms regarding EF because the measure has some weaknesses, but presently there is no tool for sustainability which is complete and none will satisfy everyone perfectly. Furthermore, the ecological sustainability is not absolutely measurable, especially not with a one-dimensional indicator (van den Bergh–Verbruggen 1999, Costanza 2000, Moffatt 2000). Nevertheless, based on our present knowledge, I regard *EF as the most comprehensive sustainable indicator*. "Since 2003, a prestigious academic and science political advisory council (Global Footprint Network Advisory Council) has been dealing with this index (since 2005 with José Manuel Barroso's support, President of the European Commission) and the footprint is already an officially accepted sustainability index in several countries (Switzerland, Germany and Finland)" (Vida 2007, p. 1603.).

The development of the ecological footprint can be influenced by many factors, for instance choosing *residence*, that is the type and location of the dwelling, the size of the house and usage of different means of transport. Obviously, if someone lives on the outskirts and drives to work every day, they leave bigger

footprint behind than if they lived in the city and covered the distance between their house and workplace on foot ceteris paribus. It is worth emphasizing the fact that in contrast to the poor, the well-to-do people have more options (for example, they can move to an expensive urban house), they can change their way of living more easily, decreasing their ecological footprint. It is questionable how much they are willing to make changes. In addition, the growing number of divorces may also contribute to the increase of ecological footprint, because two houses are needed instead of one, with double building material and expenses.

The result of EF indicator is affected by the standard and character of consumption, the technology, the population density and the size and quality of the area available for society (Wackernagel–Rees 2001). The former factors can be paralleled with the I = P • C • T formula, on the basis of which I present the elements that influence the value of ecological footprint in the following.

It is important to highlight the problem of *overpopulation*, since without solving it the ecological footprint of humanity cannot be decreased to an appropriate level. The ecological footprint of poor countries would be high in result even if rich countries reduced their consumption. If "the growth of population cannot be controlled and harmonised with basic human needs, malnutrition, wars and diseases will cause the mass destruction of people, resulting in a drastic decline in number." (Buday-Sántha 2006, p. 27.)

Analyses regarding ecological footprint point out an extremely important problem, namely while the *consumption* of rich countries exceed threefold over the Earth's biocapacity, the inhabitants' basic needs in poor countries (food, drains, electricity) are still not satisfied. Consequently the question arises about who should be urged to reduce their ecological footprint and who could increase theirs for the sake of satisfying their basic needs. 20 % of the world's population living in rich countries consumes 80% of the resources, exceeding the global carrying capacity (Wackernagel–Rees 2001). Industrial production has grown fourteen times since the 1920s; however, besides the fact that this growth has made many people rich, it has not put an end to poverty.

In developed countries the ecological footprint may be reduced by introducing *new technologies*, on the other hand, the Earth's biocapacity cannot be increased to a great extent by it. Although new technologies may seem to increase our planet's capacity, it actually stagnates and remains unchanged. Here it is worth mentioning the concept of *rebound-effect*[2], because efficiency improvement resulted by the introduction of a new technology may work against resource conservation. So the ecological footprint per capita is determined by technology and personal consumption. Thus, the ecological footprint per capita can be reduced by introduction of new technologies. In the literature of sustainability, eco-efficiency

[2] According to rebound-effect efficiency, sale and growing use of resources are closely connected to each other (Alcott 2005). E.g. in spite of the increasing fuel efficiency of cars, the total consumption does not decrease, because more and more consumers use their car more and more often.

has a significant role in relation to technological change; increasing of eco-efficiency is regarded as the principal tool for moving in the direction of sustainability. A unit (enterprise, national economy, etc.) is more eco-efficiency than the others if it produces a certain output with less environmental effect.

The reason for this is that a (relative) increase in eco-efficiency enlarges the scale of human transformation of the biosphere in absolute terms instead of decreasing it (Alcott 2005). The rebound-effect is observable both at micro and macro level. In case of households, the increased technological efficiency is typically used to enhance comfort and the standard of living instead of decreasing of resource-consumption. For example, improvement of households' energy saving leads to the increase of the size of residence, higher room temperature or the use of electric domestic tool (Hanssen 1999). In the case of enterprises it can happen that eco-efficiency improvement is followed by an increase in production so enterprises' absolute resource-use is entirely growing (Dyllick–Hockerts 2002). At the macro level, in the case of public transport in Great Britain for instance, the increase of fuel-efficiency was followed by expansion of number of cars and car-use per capita (Hanssen 1999).

Due to more efficient use of energy and material, companies can raise pay and bonus while reducing prices, which can lead to a growth in consumption. Improvement of energy-efficiency can increase energy consumption, partly by making it appear as cheaper than other input, partly by intensifying economic growth, which increases the use of energy (Alcott 2005). It is worth mentioning the advantageous consequences of the technologies based on renewable energy (e.g. solar energy). The use of solar collectors is quite expensive for the time being, but an environmentally friendly solution. It is demonstrated by the example according to which warming up a given amount of water with solar collectors leaves a hundred times smaller footprint than heating it with fossil energy (Wackernagel–Rees 2001).

It turns out that quite many components have to be considered and changed in the interest of reducing EF. Individuals (with changes in their environment, residence and consuming habits), experts and countries (with working out appropriate technologies) can contribute to the decrease, in addition they have to face such serious and hard to handle problem as overpopulation.

During my studies I familiarised myself with several indexes and procedures ISEW, HDI (Human Development Index)[3], material flow analysis (Material flow accounting and analysis – MFA), but it can be established that all methods we know at present have limited information in connection with sustainability. There has not been a procedure so far which can be accepted without criticism, covers all details and can be used with maximum precision. However, from among the existing

[3] The aim of HDI is to make economies rankeable on the basis of important values that are not measured by GDP (Kerekes–Szlávik 2003).

calculation methods, the ecological footprint has become widely accepted and used in several fields as an index to define the extent of the burden on the natural ecosystem. It is proven by the fact that WWF's Living Planet Report calculates the ecosystem burden data of the world's countries based on EF year after year (WWF International 2006). In addition, Meadows et al (2005) also use the EF for presenting the potential negative consequences of overshot, and emphasise the necessity of reducing EF.

Through moderating consumption, the development of environment-conscious consumer behaviour can contribute to decreasing ecological footprint. There is not a standard definition of environment-conscious consumer behaviour; different names exist in the literature with regard to it (pro-environmental behaviour, environment-conscious behaviour, environmentally significant behaviour).

According to Kaiser (2003), environment-conscious behaviour is all the actions that contribute to conservation and/or sustaining of nature. This, among others, includes recycling, the economical use of energy and water and commitment to the activity of environmentalist organisations.

Stern (2005) examines environmentally significant behaviour (ESB) that can be defined by its impact: the extent to which it changes the availability of materials or energy from the environment or alters the structure and dynamics of ecosystems or the biosphere itself (Stern 2005). Paul Stern (2000, 2005) differentiated four types of ESB:

1. environmental activism,
2. non-activist behaviour in the public sphere,
3. private-sphere environmentalism,
4. other environmentally significant behaviour.

Active participation means that individuals take part in the work of environmentalist organisations and demonstrations. Active citizenship (for instance membership of environmentalist organisations) is distinguished from the support or acceptance of public policies (for the willingness to pay higher taxes for environmental protection). Private-sphere environmentalism examines to what extent individuals take the preservation of environment into consideration during consumption, e.g. the use of domestic products. Thus private-sphere environmentalism has direct environmental consequences. Finally, individuals may affect the environment through other behaviour, such as influencing the actions of organisations to which they belong. From these types of behaviour I examine the private-sphere behaviour, whereas individuals' environmental effect depends on their decisions as consumers.

Environmentally significant behaviour has several versions, but Stern (1999) differentiates three fields, which show the effects of individual behaviour on environment, namely the personal, the behavioural and the contextual fields. The personal field includes the basic individual values, and Schwartz's (1992) norm-

activation theory, the value-belief-norm theory (Stern et al 1999), the theory of reasoned action (Fishbein, quoted by Stern 1999) and the planned behaviour model (Ajzen, quoted by Stern 1999). The behavioural field covers the four fields mentioned above, that is environmental activism, non-activist behaviour in the public sphere, private-sphere environmentalism and other environmentally significant behaviour. Finally, the contextual or structural field includes the individual characteristics that are typically defined from birth (cultural background, religion, social class), acquired skills (qualification), living conditions (residence in the country or in the city; tenant or owner; having a car or not), opportunities and restrictions of community politics (regulation, tax, motivation programs), economic factors (income, access to financing sources) and other factors.

On the whole, the definitions are identical in emphasising primarily the preservation of environment. The most accurate definition was given by Paul Stern (2000), so I also accept his one, which I later describe in details.

Regarding the models of environment-conscious behaviour it can be stated that almost all the models emphasise different factors which influence the behaviour. One of the oldest models (the linear flow model of environment-conscious behaviour) considered environmental knowledge and environmental attitude determining (Kollmuss–Agyeman 2002). According to others there is a contradiction between environmental attitude and environment-conscious behaviour (Rajecki 1982, quoted by Kollmuss–Agyeman 2002). In addition, among the early models Fishbein and Ajzen's (1980) theory of reasoned action appears, which has a huge influence in social psychology, one of the most frequently quoted models. Furthermore, Hines, Hungerford and Tomera's (Hungerfold–Volk 1990) model of responsible environmental behaviour can be highlighted, which is the improved version of the Fishbein-Ajzen model. The altruism, empathy and prosocial behaviour models are next ways of approaching the study of environment-conscious behaviour. The prosocial behaviour is a voluntary behaviour which appears in the form of good deeds towards other people and society. Altruism[4] itself is a subsystem of society sensitive behaviour. Several researches have built their assumptions on the theory of altruism, according to which altruism is needed for developing environment-conscious behaviour.

The most known models are Schwartz's "norm-activation model", and Stern's et al "value-belief-norm theory" (VBN Theory). Schwartz examined the general structure of values in several countries. Schwartz's value structure became current in the literature, thus this system also forms the basis of Stern's et al (1999) study. During his works, Schwartz explored human values in the field of psychology, then he divided them into ten value types (power, achievement, hedonism, stimulation,

[4] Altruism is a prosocial behaviour which is based on considering the other people's needs. It can be observed in the case of people who think that certain problems and harmful effects threaten the others, their well-being and health, and they think they are able to ease these consequences (Piliavin–Charng 1990).

self-direction, universalism, benevolence, tradition, conformity and security) and further four value categories (self-transcendence, self-enhancement, openness to change and tradition).

Stern's et al (1999) flow model takes Schwartz's model as a starting point and draws the attention to the fact that it takes a long process to develop environment-conscious behaviour. My questionnaire is also based on this model and the factors presented in it. Stern et al (1999) assumed that actions taken for the sake of a successful environmental protection are in connection with personal values, belief and norms, which motivate people to do something to achieve their aims and to protect the environment.

The authors in the course of creating VBN Theory started out from that the norm-based actions derived from three factors:

- acceptance of certain personal values,
- belief concerning that the realisation of this values may be hindered by certain factors and
- belief that actions initiated by the individual can ease the obstacle and restore the values

Stern et al (1999) examined the following five variables and the connection among them: *values* (especially environmental-altruist values), *New Ecological Paradigm* – NEP, *Awareness of consequences* – AC, *Ascription of Responsibility* – AR and *pro-environmental personal norms*.

The elements are in close connection with each other and one element affects the variable that follows it. The model starts out from the assumption that environment-conscious behaviour is in close connection with certain basic values. Stern differentiated *four value categories* based on Schwartz's work: altruist, egoist, traditional values and the openness to change. The egoist and altruist value categories in Stern's model are equal to Schwartz's self-transcendence and self-enhancement categories. The altruist behaviour appears as a response to personal ethical norms, which can be observable in the case of people who think that certain problems and negative effects threaten the others, their well-being and health; in addition, they think they can ease these effects. The egoist values include such elements as wealth, prestige and money. The traditional values include honesty and respect. The openness to new things emphasises exciting and varied life. The environmental values are in connection with the development of environment-conscious behaviour.

According to the *New Ecological Paradigm*, humanity has a significant impact on the more and more vulnerable biosphere. The NEP scale is one of the most wide-spread social psychological measuring instruments that examine the effect of humanity on biosphere, to which the harmful consequences of ecological changes can be traced back. In 1978, Dunlap and Van Liere worked out the New Environmental Paradigm – NEP, and then in 2000 it was rewritten so the New

Ecological Paradigm was created. The authors found it necessary to renew the former NEP scale, because they thought environmental problems had changed in a respect; they had become more and more global. Although certain elements, such as pollution caused by household refuse, are still local problems, the consequences of narrowing of the ozone layer, deforestation, decrease of biodiversity and climate change have global effects. (Dunlap et al 2000).

The original theory emphasises that one should be *awareness of consequences* (AC) of certain events on other people (as the main feature of altruists' values). Schwartz's general theory stresses being threatened, no matter what kind of intention stands in the centre of the values founding norm. In case of environmental protection the threatening of not human species and the biosphere can be important.

Finally, in Schwartz's theory, the activation of norm depends on the *Ascription of Responsibility* (AR), by which he means that people ascribe to themselves the causing of undesirable consequences for others, that is the belief or denial of the fact that individual people's actions contributed or eased the consequences. The generalised theory emphasises the belief in taking responsibility in connection with anything considered as value or in the ability to ease the threatening.

The authors started out from that personal norms directly affect the three forms of environment-conscious actions. All types of supporting the actions can have an effect on the individual's abilities to take the necessary steps to provide the appropriate type of support. Thus the certain types of supporting the actions are based on personal values and belief.

Stern et al (1999) also studied the theory of *cultural biases*; they differentiated four groups in their research: *hierarchy*, egalitarianism, individualism and *fatalism.* The above mentioned four categories appear in the questionnaire of my own making and I give details about the results of my research in the following.

It turns out from the results measured on NEP scale that the altruist values are in positive while the egoist values are in negative connection with environment-conscious beliefs

The third large group of environment-conscious behaviour models is models classifying social and psychological factors. Fietkau and Kessel (1981), quoted by Kollmuss–Agyeman (2002) examined environment-conscious behaviour and its lack with the help of social and psychological factors. In their "model of ecological behaviour" they studied five independent variables, which affected directly or indirectly the environment-conscious behaviour: possibilities to act environmentally, environmental attitudes and values, incentives for pro-environmental behaviour, perceived consequences of behaviour and environmental knowledge. Blake (1999) writes about an attitude-behaviour gap that he calls Value-Action Gap. According to the author, the models of environment-conscious behaviour are restricted because they ignore the individual, social and institutional restrictive factors. In addition, they assume that people are rational and they use information available for them, so

they do not care about collecting information separately and deal with only what reach them. Blake (1999) differentiates three obstacles which stand between environmental responsiveness and real action: individuality, responsibility and practicality.

Within environment-conscious behaviour we can speak about environment-conscious consumer behaviour, which is a narrower category.

Princen (1999) emphasises the harmful effects of *overconsumption*[5]. Consumption raises important questions from the point of view of both researchers and decision makers, still neither side deals with the problem adequately. Consumption is close connection with environmental problems, since people use energy and raw materials in the highest degree so far, causing serious consequences in global climate, biodiversity (diversity of species, biomes and regions), soil and further environmental factors. Beyond that, certain activities intensify the problem: the more and more widespread shopping fever, vehicles consuming a lot of fuel, luxury consumption and buying disposable products. Kollmuss and Agyeman (2002) examine three large groups in their model of environment-conscious behaviour: demography variables, external factors (institutional, economic, social and cultural factors) and internal factors (motivation, environmental knowledge, consciousness, values, attitudes, locus of control, responsibility and priorities).

According to Christensen et al (2007) three factors can lead to increased consumption if they co-exist with economic growth and increasing disposable incomes, they are: rapid production innovation, individualization and spreading of stress and time pressure. Production innovations are increasingly urging people to replace consumer goods more and more frequently with newer and more attractive ones, complying with the constantly refreshing fashion and other trends (Röpke 1999). The information and communication technology (ICT) plays an important role in the increase of consumption. Constant innovations appear in the field of computers, due especially to the continuous development of hardware. It is likewise present in the case of communication technology, mobile phones have newer and newer functions (electronic calendar, MMS, camera), which generates more consumption. The average lifespan of a mobile is about 18 months.

Countless researches can be found regarding the question: who are the environment-conscious consumers? Straughan and Roberts (1999) first examined the demographic variables which can be in connection with environment-conscious behaviour and/or consumption, these are:

- age,
- sex,
- income,
- qualifications.

[5] Overconsumption is the level which destroys the system of species' subsistence (Princen 1999).

In the case of age, the general assumption is that younger consumers are more sensitive to environmental questions, because they have grown up in times when environmental problems have already come in the fore (Straughan–Roberts 1999, Diamantopoulos et al 2003). However, researchers' opinions differ on this question; according to some researchers there is a significant positive connection between age and behaviour, others say that there is a negative correlation. In the case of sex, most researchers agree that women's attitude to environment is more positive than men's, which can be explained by that women consider the effects of their actions on others more, and they do environmentalist activities more often (Straughan–Roberts 1999, Diamantopoulos et al 2003). In the case of income, the general view is that consumers having higher income are willing to pay the higher prices of environmentally friendly products. However, in this case opinions differ; according to some researchers there is a negative connection between income and environment-conscious behaviour. Willingness to pay does not necessarily mean actual purchase (Majláth 2005). As for the study of qualifications, they draw the conclusion that qualifications correlate positively with environmentally friendly behaviour, which may be explained by that people with higher education have more information relating environmental problems and the importance of environmental consciousness.

Besides demographic variables, factors such as values and the effect of environmental knowledge have to be taken into consideration (Majláth 2005). Probably the consumers who find environmental values important pay more attention to environmental protection and prefer environmentally friendly goods to imported products.

3. Results and discussion

In my study I present the results of my quantitative survey, which was done in May 2009. The sample consists of 225 inhabitants of Szeged, Hungary[6]. My questionnaire consists of three major parts (see in Appendix):

1. ecological footprint (18 questions),
2. questions based on the VBN Theory (5 questions),
3. general demographical data (5 questions).

In the first part of this section I introduce some descriptive demographical data of my sample. Afterwards I explore the relationship between the examined variables and EF (Table 1).

[6] In 2008 we made a survey among university students of Szeged and our actual study based on the former examinations.

Table 1. Structure of my examination

Descriptive statistics	Measurement of relationships
Ecological Footprint (EF)	EF + 5 types of values
Environmental philosophy and values	EF + cultural biases
General demography	EF + NEP
	EF + adverse
	EF + responsibility
	EF + demography, especially income

Source: own construction

First I set up five hypothesis based on the literature, especially on the basis of the examinations of Paul Stern (2000, 2005), Stern at al (1999) and the literature of ecological footprint (e.g. Bagliani et al 2006). Furthermore, the hypothesis covers my former examination among the students of University of Szeged.

- H1: Respondents who prefer egoistic values have higher EF.
- H2: Respondents who think that global climate change have negative consequence for themselves have smaller EF.
- H3: Respondents who believe that single persons and small communities may play an important role in the solution of environmental problems have smaller EF.
- H4: Respondents who prefer egalitarianism (as a cultural bias) have smaller EF.
- H5: From the demographical variables income has a significant role in influencing personal EF. That is respondents whose monthly net income per capita is high have higher EF.

In the first part of my questionnaire I measured the ecological footprint of the inhabitants. There are several EF-calculators but none of them fulfilled the requirements of preciseness and intelligibility simultaneously and in addition, each of them showed different results when I tested them. First, I chose Earth Day's and Global Footprint Network's common EF method. However, in the course of the test survey the calculator proved to be difficult to understand for the students in my former examination and the questions were also too long. Therefore, in my study I used Eric Krause's ecological footprint calculator, which is intelligible but the result are not precise, it only determines the EF approximately. Moreover the major problem is that the calculators present rather different results. According to my experience, Eric Krause's calculator shows essentially higher EF results than the one of Earth Day's and Global Footprint Network's. Therefore, in our analysis I do not analyse absolute levels of EF only the relative effects of the influencing factors within our sample. Eric Krause's calculator measures the EF with 18 questions that are divided into 5 parts.

3.1. Testing the hypotheses

The average ecological footprint of the inhabitants of Szeged is between 6-7,8 gha. This number is incredibly high, it is approximately twice as large as the Hungarian average (3,7 gha).

As I mentioned above, Stern et al (1999) link five variables to environmentally significant behaviour: values (especially altruistic values), new ecological paradigm (NEP), adverse consequences (AC), ascription of responsibility to self (AR), and personal norms for pro-environmental action. In my study I measured five types of values (four from the VBN Theory completed with nepotistic values), NEP, AC, AR, and cultural biases based on VBN Theory. Later Stern (2000, 2005) examined only three values (altruistic, egoistic and biospheric values). In my study, however, I chose the first classification and below I show that our values can be divided into five types with principal component analysis – aside from several exceptions regarding the original categories given by Stern (1999).

First I formed five components with principal component analysis[7] from the values based on Stern et al (1999) – nepotistic values do not occur in the original theory. I aimed to get principal components that explain the largest proportion of the variance of the original variables. In the course of examination of the relationship between the five components and the EF, I have found that EF was positively correlated with egoistic values. Likewise EF was positively correlated with openness to change values. T*he results confirmed my first hypothesis, that is* the respondents who prefer egoistic values have higher EF (Table 2). In the other three cases there were no significant correlations.

Table 2. The connection between EF and egosim

	Ecological Footprint	**N**	**Mean**	**Std. deviation**	**Std. error mean**
Egoism principal component	4-6 ha	84	-0,1834	0,8865	0,0967
	6-7,8 ha	93	0,2038	0,9427	0,0978

Source: own calculations

In my study, NEP was measured with a short NEP-scale (consists of five statements) which were valued on a five-grade scale by the respondents. However, there were not any significant connections between EF and NEP. Earlier (among the students) I measured NEP with three statements, which were connected to the role of technology in the solution of environmental problems. The students who consider modern technology as a solution for the environmental problems without the need for changing their lifestyle have higher EF (correlation is significant at the 0,05

[7] According to our expectations the minimum value of the loading variables was 0,7. We expected the principal components to preserve 60% of the amount of the information (communality) (this is the generally expected level in social sciences).

level, Pearson Correlation is 0,126). This finding is consistent with my former hypothesis thus it has been confirmed, that is the students who consider modern technology as a solution for the environmental problems have higher ecological footprint. Consequently, techno-optimism leads to higher ecological footprint. It is easy to see that the individuals who believe development of technology is the best way may not take part in the protection of environment.

Within the category of *Adverse Consequences*, the respondents had to determine how large problem the global warming is going to mean for themselves and their family, for the future generations, for their country, for the developing countries and for other species of plants and animals. I found that the respondents primarily worry about the well-being of country, so *I refused my second hypothesis that the inhabitants who think that global climate change have negative consequence for themselves have smaller EF.* In my earlier examination I found that students think environmental problems have negative consequences principally for the next generation and they have smaller EF. I explain it with the fact that these respondents potentially have more information about sustainability than the others, since the official, scholar definition of sustainability or sustainable development is strongly connected to the well-being of future generations - see for instance the most cited definition of Bruntland (1987).

In my study I measured the *relationship between AR and ecological footprint.* First I divided the agents who may be responsible for the solution of environmental problems into four principal components with principal component analysis. My first component, "*small community principal component"* contains individuals, small communities, civil organisations, local/national environmentalist organisations and smaller settlements. Therefore these respondents expect the solution from the local level. The second one is "*mezzo principal component"* contains cities, regions/counties and countries. The third one is "*international principal component"* contains international organisations and international environmentalist organisations. Finally, the last one is "*business principal component"* contains small-, and medium-sized businesses and multinational businesses. EF was positively correlated with business category. In the other three cases no significant relationship were found. *Thus I refused my fourth hypothesis that the inhabitants who consider locality important regarding the solution of environmental problems have smaller ecological footprint.* In my earlier study I found that EF was negatively correlated with small community category. It is interesting that the inhabitants believe in the category of business.

Finally, *cultural biases* were measured using 8 statements from the research of Stern et al (1999). These items were divided into four groups: egalitarian, individualist, hierarchist and fatalist cultural bias. In the course of principal component analysis I found that my results are consistent with the original theory. I examined the relationship between the four principal components and the EF but there were significant relationships in two cases, namely between egalitarian and

individualist cultural bias and EF there is a significant relationship. *Thus I confirm my fifth hypothesis - the respondents who prefer egalitarianism have smaller EF, in addition, inhabitants who prefer individualism have smaller EF as well.*

I think it is very difficult to measure values and cultural biases based on a model which was tested in another country, because different people and nations have different means of values or, for example, statements of NEP. 'Everyone should have an equal chance to succeed and fail without government interference' statement has a different meaning for an American and a Hungarian. Consequently, it is not possible to adapt and apply models used in other cultures, however, useful information can be obtained, but it may need refinement.

In the last part of my survey I asked general demographical questions about the respondents (age, qualification, income). *My first hypothesis is confirmed since the income of the respondents is correlated positively with EF*. We can say that *higher income means higher EF*. This observation is consistent with my expectations and the results of the literature. Income plays an important role in the extent of EF, because it influences the EF through consumption. The results show that the females have smaller EF than males, furthermore the respondents who have primary education have smaller EF which can be connected with income, because generally lower qualification means smaller income. However, it is an interesting question that among people with lower qualifications diseases are more frequent, which lay considerable expense on the state and the citizens, but its extent does not appear in the course of EF measures, besides it can be measured with difficulty. During examining the age, I created four groups, namely: under 31, 31-48, 49-65 and over 65 (Table 3).

Table 3. The connection between EF and age

		Age			
		< 31	31-48	49-65	> 65
Ecological Footprint	4-6 ha	30,6 % (15)	42,9% (21)	45,8% (22)	80,6% (29)
	6-7,8 ha	69,4% (34)	57,1% (28)	54,2% (26)	19,4% (7)
	Total	100,0% (49)	100,0% (49)	100,0% (48)	100,0% (36)

Note: the number of respondents are in brackets
Source: own calculations

As for the distribution according to age, inhabitants' EF over age 65 is the lowest, while inhabitants under 31 have the highest EF, which also can be related to consumption, as the younger age group consumes much more and they are more open to novelties (see newer and newer mobile phones).

4. Conclusion

Ecological footprint shows that humanity's effect on environment is already unsustainable. From the three factors determining EF, developed countries could make steps in the field of technological development and most of all in the field of consumption. Relying on the literature we can say that the increase of eco-efficiency itself – besides current consumption values – does not lead to the decrease of EF (because of the rebound-effect). For this reason the key issue for the developed, western countries is the transformation of values that is people could move towards the ecological values from consumption values.

In my study I seek answers for the above-mentioned problems with an empirical research. I emphasized some important conclusions from my results:

- Inhabitants who prefer egoistic or openness to change values have higher EF.
- Inhabitants who think that global warming is a serious problem for their country. (Consequently they do not consider it a problem for themselves yet).
- Inhabitants who believe in effect of small and medium sized enterprises and multinational businesses have smaller EF.
- The wealthier inhabitants have higher ecological footprint and from all the examined variables income influences the EF to by far the highest extent.

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Technological Change and Environmental Sustainability: Limits of Techno-Optimism

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Technological change is often considered to be a means of achieving sustainable development, since it may increase eco-efficiency and substitute natural capital with man-made capital. However there are several hinders of introducing such innovations, furthermore the more efficient use of natural resources does not necessarily result in their decreased consumption at the macro level.

Present paper analyses the relation between technological change and environmental sustainability. It focuses on three main issues: first, eco-efficiency and substitution, second, uncertainty and reflexivity and eventually the rebound effect. In all the three fields we identify mechanisms that question the ability of technological change to induce a shift towards sustainability. In the existing structure – but not necessarily – technological change seems to be rather part of the problem than the solution in connection with sustainability.

Keywords: technological change, sustainability, evolutionary economics, uncertainty, rebound effect

1. Introduction

Technological change has been a core research topic in economics for decades now, however its exact relationship with natural environment and sustainability is a relatively young (and by no means central) issue. At the same time, the two major schools that examine the economy-environment relation (environmental economics and ecological economics), have accumulated abundant theoretical and practical knowledge in this field.

Beside scientific publications the issue is obviously present at political and public discussions as well. The political position concerning sustainability treats technological change unambiguously as part of the "solution". More efficient use of natural resources or the reduction of the amount of waste appears in several documents as principal ways of the shift towards sustainability (Bruntland 1987, Stern 2006).

In scientific debates a wide range of approaches are articulated. At one end stands a view that considers technological change as the main opportunity for the shift towards sustainability. At the opposite end stands a viewpoint that regards it as the main cause of problems. In economics the "techno-optimist" approach is rather expressed by environmental economics, while "precaution" is propagated by

ecological economics. It is important to declare that in certain aspects the border between the two schools is quite blurred. But in connection with the role they assign to technological change with respect to sustainability their approaches and conclusions are sharply distinct (Málovics–Bajmócy 2009).

In present paper we analyze the relation between technological change and environmental sustainability along three topics. In the first chapter we are dealing with the subject of eco-efficiency and substitution. The second chapter focuses on uncertainty and reflexivity, while in the third chapter we examine the rebound-effect and one of its special forms, namely the Jevons-paradox. At the end we draw our conclusion with respect to the relation of technological change and sustainability.

2. Eco-efficiency and substitution

The standard view of economics normally focuses on two basic aspects of technological change: the *increasing productivity* (change in the shape of the production function) and the *new ways of substitution* among factors of production (Mátyás 2003, Samuelson–Nordhaus 2000, Wentzel 2006). These characteristics of technological change provide possibilities in economizing with resources (also with natural resources).

The more efficient use of the factors of production (economizing) is a basic interest of enterprises, at least in case when they purchase them in the market[1] Technological innovations that enable economizing are stimulated by market forces. By increasing the productivity (eco-efficiency) of natural resources, the innovator will be able to reach a lower cost per piece compared to their competitors or will be able to provide more favourable solutions to the consumers (e.g. the significant reduction in the specific energy-consumption of lighting bulbs or the fall in the per kilometre fuel consumption of vehicles). But even in case of the significant improvement in eco-efficiency, the substitution of a given resource may become inevitable sooner or later.

One of the most heated dispute in connection with the role of technological change focuses right on the relation of natural and artificial (man-made) resources. If these types of resources were *substitutable*, than the concept of weak sustainability[2] would be acceptable. In other words it would be enough to sustain the sum of the value of the two types of capital, to create artificial capital in the value of the terminated natural capital (Harte 1995, Gutés 1996, Kerekes 2006).

[1] In present paper we can not deal with the pricing problem of natural resources in detail. However we must note that market prices do not necessarily indicate the scarcity of natural resources, or pricing may even be impossible (Gowdy 1997).

[2] According to the concept of weak sustainability natural and man-made capital are basically substitutable. In order to fulfil the criterion of sustainability the sum of the values of the two capital-types must remain constant. In other words, when the value of the natural capital decreases, it is enough to create man-made capital with the same value.

This substitution is direct if a new (more precise) device enables us to decrease the amount of waste (pollution), to utilize formerly un-utilizable resources or to recycle more efficiently (Solow 1997, Stiglitz 1997). A more important form is however the indirect substitution, when products that formerly were made from non-renewable resources are now produced from renewables with the help of processes with great capital-intensity (Solow 1997).

But in case the natural capital can not be fully substituted, it constitutes an absolute external sustainability barrier, and a minimal level must be inevitably saved. According to our present knowledge nature provides such ecosystem services[3] to the economy that practically can be substituted neither by each-other, nor by man-made technology (UNDP et al 2000, Gustaffson 1998, Daily 1997, Gonczlik 2004)[4].

According to the standard economic arguments (on which environmentally economics builds to a great extent) technological change that enables substitution is basically generated by market mechanisms (the changes in the relative prices). The effects of relative prices on the direction and speed of technological change is analyzed in detail by the induced innovation theories (Ruttan 1997). Fundamentally they reach back to the hypothesis of Sir John Hicks put forth in 1932, in which he argued that "a change in the relative prices of factors of production is itself a spur to innovation, and to inventions of a particular kind – directed at economizing the use of a factor which has become relatively expensive" (Jaffe et al 2003, p. 470.).

Therefore market mechanisms, by signalling the scarcity of given resources, provide an incentive to economic actors to use other (potentially yet unknown) resources. This process and the ability to increase eco-efficiency lead to sustainable growth.

However *ecological economics* is rather sceptic about the abovementioned interpretation of technological change. On the one hand it criticizes induced innovation theories on the basis of the achievements of evolutionary economics, on the other hand it questions the presumptions of the weak sustainability concept.

Two main set of critical arguments towards induced innovation theories can be outlined. The first set of critics stand on the basis of positive feedbacks mechanisms linked to the use of technologies, which also infers the path-dependency of technological change. The use of a given technological solution provides additional advantages to both the producer and the consumer. On the top of

[3] The most important types of ecosystem-services are: production services (e.g. food, resources, fodder), regulating services (e.g. climate, flood protection, pollination), cultural services (e.g. education, recreation, inspiration for art) and provisioning services (e.g. nutriment circulation) (MEA 2005).

[4] We must note that ecological economics does not necessarily propagate strong sustainability as an alternative for weak sustainability. This is because in the strong sustainability concept the criterion of sustainability is the constant value of natural capital, which presumes the existence of an objective valuing method. Ecological economics however questions that such a method could exist (Málovics–Bajmócy 2009).

this it generates negative externalities towards the other competing solutions. Thus the world of technological change can be characterized by positive feedbacks and dynamic increasing returns (David, 1985, Arthur 1989, 1990, Page 2006). Therefore technological change has such characteristics that totally "rewrite" the standard allocation problems of economics that presume constant or decreasing returns (Arthur 1989, 1990):

- *Non-predictable*: the long-run market shares of the technological solutions can not be predicted, uncertainty does not "averages away".
- *Non flexible*: a subsidy or tax adjustment to one of the technologies' returns can not always influence future market choices.
- *Path-dependent* (non-ergodic): different sequences of choices lead to different market outcomes.
- *Not path-efficient*: such a situation may occur, when it is worth to choose one of the alternatives just because of the past decisions. In other words "lock-in" may occur, when a technological solution proves to be more valuable than all its alternatives just because enough people had already chosen it.

This means that when consumers or companies chose from different (e.g. polluting or less polluting) technological solutions, they do not solely consider the characters of the given solutions (and their own preferences), but also the effects of the earlier decisions. New technological solutions does not appear with a "clean slate", they must compete the positive feedback mechanisms backing the existing solutions.

On the top of this several other factors may also strengthen positive feedbacks, such as institutional or infrastructural changes (Nelson 1995), and relational systems occurring parallel to (or in co-evolution with) the spread of the technologies (Witt 2003). The historically developed structures are not only able to select out the incompatible novelties, but are also able to shape the direction of the search process. A widely accepted opinion may occur with regard to the relevant problems and the desirable directions of research and development – a technological regime or paradigm (Dosi 1982, Kemp et al 1998).

Therefore *several barriers may hinder the spread of technological solutions with increased eco-efficiency or solutions that provide new ways of substitution*. The replacement of the existing (optionally less advantageous) solutions can be seriously hindered by the historically developed structures, systems.

The other set of critical arguments towards induces innovation theories question the implicit presumption under which economic actors would always be able to predict their needs, and enforce the emergence of the new solutions with optimal productivity characters. According to the evolutionary interpretation of technological change the global objective function, the definite set of choices, maximizing behaviour and rational decision making are indefensible presumptions (Nelson–Winter 1982, Dosi–Nelson 1994).

Uncertainty is an inherent element of the process of technological change. It is not solely a problem of information gathering but an integral part of the process (Hronszky 2005). This is a clear consequence of the abovementioned positive feedback mechanisms, but also well underpinned by the theories that analyse the process of innovations in depth (Marinova–Phillimore 2003, Fagerberg 2005).

3. Uncertainty and reflexivity

Uncertainty does not only appear in connection with the direction of technological change but also regarding the social and environmental effects of innovations. The systemic nature of the biosphere and the high number of factors influencing certain technological situations (Ropolyi 2004) make it even theoretically impossible to predict the potential effects of the new solutions. In addition, new solutions may alter the circumstances in which they emerged, and thus their own potential effects as well (*reflexivity*). A significant part of today's new technological solutions aim to remedy the (often unforeseen) problems caused by the former solutions (Beck 2003).

Therefore, we have a good reason to assume that new technological solutions will have such (e.g. environmental) *effects that cannot be estimated in advance*. In addition, the time for the potentially necessary adaptation becomes even shorter because of the accelerating innovation activity.

The handling of these effects becomes even more problematic if we consider the fact that many of the effects of new technologies cannot be perceived "in the usual way" (i.e. with our senses). These risks of modernization – as Beck (2003) denominated them – are based on casual interpretations and come into being through the scientific knowledge on them. Thus their recognition (even the acknowledgment of their existence) and the search for solutions are to a high extent influenced by social processes and institutions.

The shift in the discipline of technology assessment – a method for the research of the future effects of new technologies – illustrates well the aforementioned characteristics of technological change. The hard (expert) methods which were originally peculiar to the area systematically reached their limits, therefore the focus shifted towards the involvement of the widest possible range of stakeholders, and thus the consideration of the plurality of possible aspects and interpretations (Schot 2001, Hronszky 2002). In addition, the emphasis increasingly shifted from valuation to influencing (even in the early phases of development), since the possibilities of alteration – owing to the positive feedback mechanisms – may be seriously limited later.

4. The rebound effect

We considered the *rebound-effect* to be the third significant area regarding the relations of technological change and sustainability. This notion refers to the phenomenon that the increase in the productivity of a given natural resource does not result in the decrease of the absolute use of the given resource to such an extent that could be expected on the basis of the eco-efficiency gain. Moreover, in many cases productivity-increase goes hand in hand with the even more intense use of the given resource (this latter case is the so called *Jevons-paradox*).

The growth in fuel efficiency in the case of cars for example went hand in hand with the growth in the number of cars and kilometres driven (Kemp et al 1998, York 2006). A growth in household size and electric household appliances, and also higher room temperature were observed parallel to the introduction of energy efficient solutions into households (Hanssen 1999).

Fouquet and Pearson (2006) report the parallel growth of lighting-efficacy and the absolute energy need for lighting in the United Kingdom in very a long (several hundred years) time-scale. During this period lighting-efficacy has been multiplied by more than 700 times, still, energy use connected to lighting has been multiplied by 6600 (Table 1). Due to the relative cheapness of lighting an increased number of people could afford it, and new utilization methods (e.g. outdoor lighting) could emerge, which eventually resulted a sharp increase in the total energy consumption.

Table 1. Changes in the price, efficiency and consumption of domestic lighting from 1800 to 2000

Year	Price of lighting fuel (%)	Lighting efficacy	Price of light per lumen (%)	Consumption (lumen-hours per capita)	Real GDP per capita
1800	100	1	100,00	1	1
1850	40	4	26,80	4	1
1900	26	7	4,20	86	3
1950	40	331	0,15	1544	4
2000	18	714	0,03	6641	15

Source: Fouquet–Pearson (2006) and Herring–Roy (2007, p. 197.)

Rebound-effect can not only emerge regarding the use of the resource at stake. The growth in the eco-efficiency of a given resource may be the source of effects emerging at higher levels of aggregation. Thus, we may distinguish different rebound-effect types, such as (Herring-Roy 2007):

- direct,
- indirect, and
- economy-wide rebound effects.

In case of *direct rebound effect* the demand for the products and services of enhanced eco-efficiency grows as a result of the decline in the relative price of the used factors. This may enhance the total use of resources. First, we may buy more from a certain product (e.g. when the price of fuel/kilometre falls we have the chance to drive more), and second, the product or service may become accessible for new consumers (e.g. the spreading of air-conditioning).

Indirect rebound effect refers to the phenomena when we spend our savings arising from efficiency increase on other resource-intensive products or services (e.g. luxury goods). Households may spend their savings coming from more efficient heating on overseas holidays. The save in resource use coming from more efficient heating is thus lost because of the growing fuel use of airplanes.

Similar processes may take place on the producer-side as well. For example an energy-efficiency increase in steel production reduces the relative price of steel. This may reduce the price of cars which enhances their demand. This process expectedly enhances fuel use.

Economy-wide effect refers to the process that technological development and changes in consumer preferences allow new (formerly not known) ways of factor use. Increasing eco-efficiency may significantly contribute to such new utilization forms, since economic actors in their investment decisions prefer technologies that are based on the relatively cheap factors. For example, the use of electricity became common in many areas where no non-renewable resources were used earlier (e.g. watches, escalators, air conditioning etc.).

Articles on rebound-effect agree that users "take back" a certain part of savings coming from eco-efficiency increase (Alcott 2005, York 2006, Sorell 2009). But the literature is not at all unified regarding the extent of the rebound-effect and the casual relationship between efficiency increase and growing total resource use.

It is practical to measure the *extent of the rebound-effect* as a percentage of the expected resource-saving (due to efficiency-increase). This extent is at almost every occasions above zero, but according to some authors only exceeds one hundred (and thus causes an increase in total resource use) in special cases. It is quite hard to conclude this debate, since on the one hand empirical cases supporting the Jevons-paradox usually focus on energy intensive technologies with a wide range of utilization opportunities (Sorell 2009), and on the other hand empirical investigations are necessarily limited to a specific period, economic sector or country (or group of countries) (Alcott 2005).

Still, numerous aforementioned examples and other empirical data (Polimeni–Polimeni 2006) show that it is not at all rare that growth in resource-efficiency and absolute resource use go hand in hand. Still, it is quite difficult to prove any causality since the growth in absolute resource use may derive from a lot of other factors and the methodology of the empirical analyses dealing with the Jevons-paradox is not conclusive in this respect (Alcott 2005, Sorell 2009).

What can be stated however is that saving opportunities deriving from enhanced eco-efficiency can never be fully realized. The increase in the absolute use of a given resource (and even more likely in the economy-wide absolute resource use) can especially be expected in case of resources with wide utilization opportunities and the strong path-dependency of the related technologies. Thus we can suppose that enhancing eco-efficiency is in itself not enough to generate a shift toward sustainability, moreover, it may even have an opposite effect.

5. Summary and conclusions

We reviewed the relationship between technological change and sustainability in our paper. We analyzed three topics: eco-efficiency and substitution, uncertainty and the reflexivity of technological change and the rebound-effect. In all three fields we explored mechanisms that question the ability of technological change to generate a shift towards sustainability.

Market mechanisms have a limited ability to enforce the occurrence of solutions with increased eco-efficiency or substitutes for the scarce resources. The main reasons for this are the positive feedback mechanisms that are linked to technological change. Furthermore, it is sensible to presume that the substitution of ecosystem services with man-made capital can not be simply solved in each case.

On the top of this *new technological solutions almost necessarily infer new, until that time unknown problems* (new environmental problems among others). Therefore technologies that were originally created to remedy environmental problems generate the new problems partially themselves. This is caused by the inevitable uncertainty that characterises technological situations.

The third range of problems are in connection with the macroeconomic (rebound) effects induced by enhanced eco-efficiency. A number of mechanisms exist in the economy that *transfers the savings gained from the increased efficiency towards a higher level of resource use*. These processes lead to the increased use of the resource in several cases. This is ultimately due to the new utilization opportunities provided by technological change, the path-dependence of change and the maximizing behaviour of the economic agents.

Therefore within the existing structure we can not expect that technological change (more eco-efficient or waste reducing and –treating solutions) would result in a shift towards sustainability. Within present circumstances – but not necessarily – technological change is rather part of the problem than the solution with regard to sustainability.

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